Brit C
Prov. Museum

Alien Animals in British Columbia

Handbook

LEGISLATIVE LIBRARY
WITHDRAWN
DEC 28 1979
CEIVED

British Columbia Provincial Museum
Victoria Canada

FIRST EDITION 1972
SECOND (REVISED) EDITION 1972

LITHOGRAPHED IN CANADA BY K. M. MacDONALD, QUEEN'S PRINTER, VICTORIA, BRITISH COLUMBIA

104-03900/

BRITISH COLUMBIA PROVINCIAL MUSEUM
DEPARTMENT OF RECREATION AND CONSERVATION

HANDBOOK No. 14

ALIEN ANIMALS
IN BRITISH COLUMBIA

By G. Clifford Carl and C. J. Guiguet, 1957
Revised, C. J. Guiguet, 1972

Illustrations by Frank L. Beebe

Printed by K. M. MacDonald, Printer to the Queen's Most Excellent Majesty
in right of the Province of British Columbia.
1972

BRITISH COLUMBIA
DISTRIBUTION MAP
BRITISH COLUMBIA PROVINCIAL MUSEUM
Scale of Miles
0 50 100 200
132°
128°
124°
120°
116°
60°
56°
52°
50°
54°
130°
126°
122°
118°
114°
ATLIN
TELEGRAPH CREEK
Cassiar
Districts
Rocky
Mountains
Peace
River
District
ALASKA
PRINCE RUPERT
QUEEN
CHARLOTTE
ISLANDS
HECATE STRAIT
Caribou
Districts
PRINCE GEORGE
QUEEN
CHARLOTTE
SOUND
PACIFIC
OCEAN
VANCOUVER
NANAIMO
ISLAND
VANCOUVER
VICTORIA
KAMLOOPS
Okanagan
Kootenay District

TABLE OF CONTENTS

	Page
Introduction	7
Section I—Introduced Mammals	10
Opossum	10
European Rabbit	11
Eastern Cottontail Rabbit	12
Gray Squirrel	13
Norway Rat	15
Black Rat	17
Alexandrian Rat	17
House Mouse	17
Nutria	19
Red Deer	20
Fallow Deer	22
Domestic Stock	23
Section II—Introduced Birds	25
Sage Grouse	25
European Grey Partridge	25
Chukar Partridge	27
Bob-white Quail	29
California Quail	30
Mountain Quail	32
Ring-neck Pheasant	35
Black Game	35
Capercaillie	36
Wild Turkey	38
Rock Dove	39
English Skylark	40
European Starling	42
Crested Mynah	45
House Sparrow	45
Section III—Introduced Fishes, Frogs, and Turtle	47
Atlantic Salmon	47
Brown Trout	48
Speckled Char	49
American Shad	51
Striped Bass	52
Largemouth Bass	53

Section III—Introduced Fishes, Frogs, and Turtle—*Continued*

PAGE

Smallmouth Bass ... 54
Pumpkinseed or Sunfish ... 55
Black Crappie ... 56
Yellow Perch ... 57
Brown Catfish or Brown Bullhead ... 58
Black Catfish or Black Bullhead ... 59
Carp ... 60
Tench ... 62
Goldfish ... 63
Mosquito Fish ... 64
Green Frog ... 65
Bull Frog ... 66
Snapping Turtle ... 67
Section IV—Introduced Invertebrates ... 68
Japanese Oyster ... 68
Eastern Oyster ... 69
Soft-shell Clam ... 71
Japanese Little-neck Clam (Venerupis) ... 72
Japanese Oyster Drill (Ocenebra) ... 74
Eastern Oyster Drill ... 75
Eastern Mud Nassa ... 76
Lobster ... 76
Slugs ... 78
Isopods or Sowbugs ... 80
Miscellaneous Species ... 82
Japanese Clam (Trapezium) ... 83
Japanese Oyster Drill (Purpura) ... 83
Atlantic Slipper Limpet ... 84
Asiatic Anemone ... 84
Oyster-eating Flatworm ... 85
Oriental Parasitic Copepod ... 86
Gribble ... 86
Atlantic Shipworm ... 86
Earthworms ... 87
Millipede ... 87
Section V—Transfers within the Province ... 88
References ... 95

PREFACE

Handbook 14, *Alien Animals in British Columbia,* was first published in 1957. Since that time, a period of 14 years, new introductions have been made, overlooked records have come to light, mistakes have been rectified, and much has apparently remained unchanged. Known changes are included in this revised edition of *Alien Animals in British Columbia.* However, it is most unlikely that all of the changes that have taken place were picked up. Readers aware of errors or omissions are asked to notify the Curator of Birds and Mammals at the museum.

I am greatly indebted to Dr. Tom Northcote of the Fish and Wildlife Branch, Fisheries Research Section, for information and advice, through the Regional Fisheries Biologists of the Province, in revising Section III; and to Dr. Daniel Quayle of the Pacific Biological Station for similar kindness in the revision of Section IV. These sections were prepared for the first edition by the late Dr. G. C. Carl. They deal with lower vertebrates and invertebrates and are somewhat removed from the bird and mammal sections for which I am responsible. Without the help of the above-mentioned specialists the revision would have been very difficult indeed.

As in the original publication, insects are omitted here. Interested readers may find partial lists in various publications (Bucknell, 1929; King *et al.*, 1955; McLeod, 1951, 1954).

The writer again acknowledges those who contributed to the first edition, contributing game biologists of the Fish and Wildlife Branch, critical reading by Dr. B. Foster, publication details by Dr. A. Szczawinski, and typing by Miss M. Paul.

C. J. G.

Alien Animals in British Columbia

INTRODUCTION

The complete history of any area cannot be recorded without some reference to wildlife because wherever man chooses to live the plant and animal life undergoes change. Major changes are brought about by clearing the land, burning forests, draining swamps, damming rivers, polluting water systems, and by shooting and trapping, all of which affect the native flora and fauna. Further upsets, sometimes of a drastic nature, are caused by the deliberate and accidental introduction of foreign species.

It seems that human beings are never satisfied with what they find in a new land. There are always some individuals who try to improve matters by bringing in plants and animals, possibly from their homeland (before government control is brought into effect) or by pressing authorities to introduce foreign forms believing that they will provide something lacking in the native species.

Fortunately, most such introductions are unproductive; that is, the imported plants or animals fail to become permanently established. This apparently has been so in the case of many English and European songbirds released in various parts of British Columbia early in the 1900's and also in the case of Atlantic salmon, which were poured into many river systems in 1905 to 1933.

Occasionally, however, the introduced forms persist in small numbers or in restricted areas, having little or no effect upon native species. Such seems to be so in the case of Eastern brook trout (speckled char) and possibly mountain quail and European skylark.

On the other hand, some introductions have had rather disastrous results. The release of European house sparrows and starlings in eastern North America has been followed by an invasion of the entire continent by these birds, causing immeasurable damage and resulting in the expenditure of large sums of money

in vain attempts at control. Fortunately, importations such as these cannot now be made easily, thanks to government regulations and alert officials at ports of entry.

A large proportion of the alien species of both plants and animals now found in this Province have undoubtedly come in by accident. This is certainly true of most of the weeds and the majority of insect pests that are not indigenous. It is also true of the Japanese oyster drill or whelk found on certain beaches, the garden slugs, the sowbug, domestic rats, the house mouse, and other species that no person would deliberately import for release. Government control has reduced the possibility of further unwanted importations, but unfortunately this has been offset to some extent by greatly increased traffic, especially since the advent of air transport. Moreover, protective measures at the borders do nothing to prevent the spread within the Province of these undesirable aliens. Earwigs, slugs, house mice, and other pests have now been carried to most centres of population along the various traffic lanes that connect our urban areas so that the establishment of these aliens has been greatly hastened.

Some foreign forms have come into the Province "under their own power"; that is, through the natural spread of the species from neighbouring areas. Thus the carp and the tench have entered British Columbia via the Okanagan River system, which flows south through Washington and into the Columbia River, and the shad has invaded our coastal waters by spreading northward from California. The California quail of the mainland, the Eastern cottontail, and the opossum have all moved into this Province via Washington and other states to the south; so also has come the European starling, possibly from the south or from the east, the point of origin in this case being the State of New York, where these birds were first introduced.

Why is it that plants and animals that are inconspicuous and relatively innocuous in their original habitat sometimes become pests when introduced into a new area? The general opinion seems to be that the increase in numbers to pest proportions is due to the lack of natural control factors, such as diseases, parasites, and predators, which tend to keep populations down in the homeland of the species.

There are probably other factors that contribute to rapid multiplication of numbers in a new country. Lack of competition for food and for space undoubtedly helps in allowing a new-comer to become firmly established. This is evident each time a garden or lawn is planted. Weeds rapidly "take over" unless some type of control is adopted. Lack of competition may also have been partly responsible for the establishment of the Japanese oyster in certain areas along our coast since this species tends to occupy beach levels not normally used by the native oyster and other potential competitors for space. This factor undoubtedly was the major one in permitting deer to become so quickly established on the Queen Charlotte Islands, although lack of predators such as cougar and wolf may also have had a favourable influence.

Unfortunate situations also may arise if the introduced plant or animal hybridizes with a closely allied native species. Several examples of cross-breeding with detrimental results are given by Levi (1952) and Lindemann (1956).

A number of transplants have been made within the Province of British Columbia which are not, strictly speaking, introductions of foreign species since political boundaries have not been crossed. Nevertheless, the same situations may exist as occur when alien forms are introduced into new areas with the result that over-populations may develop for a time and a certain amount of damage may be done. Details of all the transfers that have taken place within the Province are not known, particularly in the case of those that were unauthorized, but an attempt is made in this booklet to include all those of which any record exists.

G.C.C.
C.J.G.

SECTION I—INTRODUCED MAMMALS

OPOSSUM

Opossums (*Didelphis marsupialis virginiana* Kerr) were introduced on Camano Island and at Sedro Woolley, Washington, about 1925 and have apparently become established there.

Two specimens killed at Crescent Beach, British Columbia, in December 1949, are the first records for the Province. The animals are believed to have originated from the Washington introductions.

Opossum.

Present status in British Columbia: The opossum, since 1949, greatly increased in numbers and extended its range up the Fraser Valley, south and east of the river as far as Spuzzum. It was recorded north of the Fraser River, at Point Grey in 1965. (B. Gates 1971.)

The opossum is a greyish coloured marsupial, about the size of a cat, with a long naked tail, and large naked ears; each hind foot has five toes, the first one large and apposable. The head is long with a slender pointed face; the entire animal is singularly rat-like in appearance. Females have a fur-lined pouch on the lower abdomen.

The original range extends along the eastern and southeastern United States, and in the northern part from the Hudson valley westward as far as the Great Lakes. It is also found in California, where it was introduced between 1905 and 1910.

European Rabbit

The European rabbit (*Oryctolagus cuniculus* L.) probably arrived in British Columbia with early settlers. It has long been raised domestically for food and fur. Inevitably some of these domestic animals escape or are turned loose and go feral.

European rabbit.

In British Columbia stock is known to have been released in several areas over the years. Bare Island, Chatham Island, Strongtide Island, Piers Island; Vancouver Island in the Sooke area, the Highland District, and McGee Swamp; South Pender Island, Graham Island, Queen Charlotte Islands, Triangle Island, all harboured populations of rabbits that flourished and most passed away since about 1910. Today to our knowledge only Sidney Island, Triangle Island and, sparsely, Vancouver Island from Sooke to Goldstream, retain appreciable populations of these mammals (B. Thomas 1970) (J. Todd 1970).

The European rabbit needs little description. Typically rabbit-like in form, it weighs about 3 pounds on the average and is brown the year around. Albinos have been developed by human agency, and albinism, partial albinism and some melanism are not uncommon in wild stock. The high breeding potential of this rabbit and its tendency to excavate complex underground burrow systems, which leads to rapid and serious soil erosion, make is a most undesirable animal.

The original range is believed to be in countries bordering the western Mediterranean. The species is considered to have been spread northward by human agency and is now plentiful throughout Europe and the British Isles. Rabbits have also been introduced to many other parts of the world. The nearest point of heavy infestation is San Juan Island in the State of Washington.

Eastern Cottontail Rabbit

Introduced to several counties in Washington between the years 1926 and 1933, this species (*Sylvilagus floridanus* (Allen)) crossed the International Boundary and became established in the vicinity of Huntingdon, British Columbia. First records were secured by A. Racey (1953) in January 1952, but animals had been seen in the area since 1950.

Present status in British Columbia: The population has spread south of the Fraser River from the Huntingdon area through the Fraser Valley, Cloverdale, Cultus Lake, Langley Prairie to Tsawwassen. It was introduced to Vancouver Island in 1964/65 by Dick Vandemeer and appears now to be firmly established in the

Eastern cottontail rabbit.

Sooke-Metchosin area with records north to Copper Canyon and west to Sooke Lake. Stock is *S. f. mearnsi* from southern Ontario (Vandemeer, 1971).

This animal is a small, short-eared rabbit weighing between 2 and 3 pounds. It retains brown pelage the year around, and is similar in appearance to the native mountain cottontail of the southern Interior.

Original range of the eastern cottontail (two subspecies represented (*mearnsi* and *alacer*); central United States from the Great Lakes south to the Gulf of Mexico, east to the Alleghany mountains, and west to central Kansas.

Gray Squirrel

Gray squirrels (*Sciurus carolinensis pennsylvanicus* Ord) were introduced to Stanley Park at Vancouver shortly before 1914. Three or four pairs were released from stock believed to have been obtained in Ontario. They had become established by 1920.

Gray squirrel.

Present status of the species in British Columbia: Robinson and Cowan (1954) in their study of the Stanley Park population indicate that this species has stabilized at the level attained in 1920, which numbers from 25 to 60 animals, based on a census taken from June through August. The animals, still confined to Stanley Park, are present there in large numbers (B. Gates 1970) (A. Best 1970).

This animal is typically squirrel-like in form but larger than our native squirrels, and with a longer, flat bushy tail. Colour is grey, with rusty tinges, but a black colour phase is common.

Normal range is in deciduous forested areas of eastern North America, north to New Brunswick and Ontario, south to Florida, and west to Minnesota.

Norway Rat

The Norway rat (*Rattus norvegicus* (Berkenhout)) originated in Japan and possibly in eastern Asia. It was spread around the world largely by man, arriving in Europe in the 1550's, in England about 1728 and in North America about 1775. Exact date of arrival in British Columbia is unknown.

This species competes with black and Alexandrian rats and displaces them along the water fronts of man and in the lower parts of his buildings. Black and Alexandrian rats are better climbers than the Norway rat and adapt better to living in natural environments away from the haunts of man.

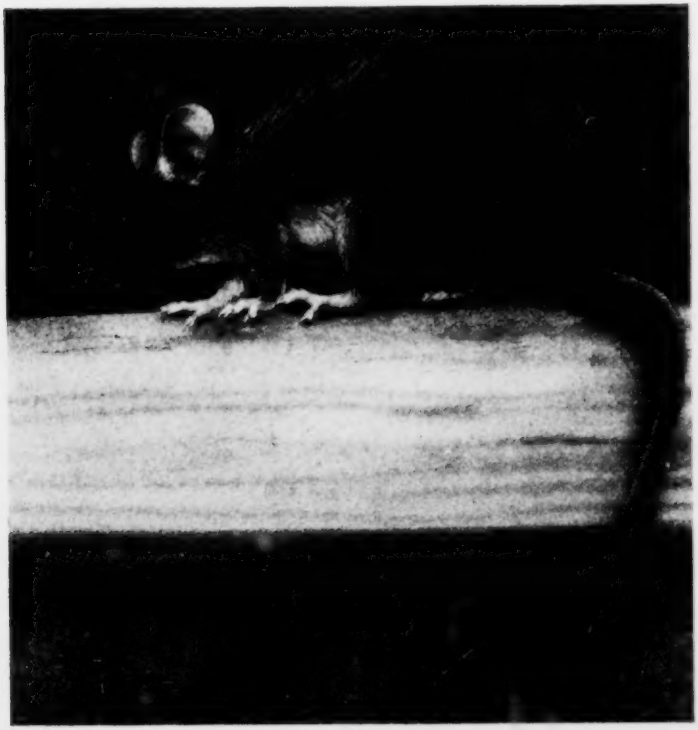
This species requires little description. It is larger than the black and Alexandrian rats, and has coarser, brown-coloured

Norway rat.

pelage. The three kinds of introduced rats have three rows of tubercles on the molars (characteristic of old world rats and mice) as opposed to two in the new world rats and mice.

The Norway rat is well established throughout settled areas in British Columbia.

Imported to North America from Europe, with type locality given as England.



Black rat.

Black Rat

This rat (*Rattus rattus rattus* (L.)) differs from the Norway rat in being black or dark grey above and below, smaller, more slender, and with a longer tail. It apparently arrived later than the Norway rat (dates unknown), but it cannot compete with that species where the two come in contact. It is less common than the Norway rat in most areas of the Province, but is well established in the wild on the Queen Charlotte Islands and in the mountains adjacent to Vancouver, breeding with the Alexandrian rat in both areas. It has been recorded also from the lower mainland and Vancouver Island.

The black rat invaded Europe from Asia Minor and the Orient, probably in the Ninth Century and at the time of the Crusades. It may first have been introduced to North America from Asia or northern Europe; type locality is given as Uppsala, Sweden.

Alexandrian Rat

The Alexandrian rat (*Rattus rattus alexandrinus* (Geoffroy-Saint-Hilaire)) resembles the black rat in size and form, but is brownish-grey in colour with a white belly. It breeds freely with the former where the two subspecies come in contact. It is well established in the wild on the Queen Charlotte Islands, and has been recorded from Vancouver Island and the lower mainland. The dates of introduction are unknown.

The original range of stock introduced to British Columbia is North Africa; type locality, Alexandria, Egypt.

House Mouse

The date of introduction of this species (*Mus musculus domesticus* Rutty) to the Province probably coincides very closely with that of the arrival of the white man. This animal is found practically everywhere that man has settled in North America, although it has not penetrated yet to most coastal islands and the Queen Charlottes. It does occur on Vancouver Island. Although habitu-

ally found around buildings, it also forages in the fields and brush where climatic conditions are suitable.

The house mouse is so well known little description is needed. It differs from our native mice in having a seminaked tail, and in having three rows of tubercles on the molar teeth. It is dull grey with ashy-coloured underparts.

This is a European import; the type locality is given as Dublin, Ireland.

Alexandrian rat.

House mouse.

NUTRIA

The nutria or coypu (*Myocaster coypus bonariensis* (Geoffroy-Saint-Hilaire)) has been imported to British Columbia over a period of years, beginning about 1938. It is believed the first ones were brought in by a resident of Ladner at that time for the purpose of fur-farming. A few of these animals have escaped from time to time and are reported occasionally on the lower mainland and on Vancouver Island.

In some parts of the United States feral populations of nutria have become established, to the serious detriment of large tracts of marsh lands and the native fauna therein.

Present status in British Columbia: No large feral populations so far established; occasional records only.

The nutria is a large aquatic rodent with a round scaly tail bearing some coarse hairs. It is brown in colour, and the hind

toes are webbed. The normal range is along waterways and marshes in South America.

Nutria.

Red Deer

In 1914 the Game Commission brought a buck and three does of the red deer (*Cervus elaphus* L.) to British Columbia from New Zealand, to which country the species had been introduced from Europe. The animals were kept at the game farm at Chilliwack until 1918, when they were released near Masset on the Queen Charlotte Islands.

Present status of the red deer in British Columbia: In 1946, the late Ronald Stewart, long-time resident and then special Dominion Waterfowl Officer on the Charlottes, reported that the animals had formed a fairly large herd, which declined abruptly

Red deer.

during the years of World War II. The decline was attributed to overhunting by transient service personnel according to local residents. This seems unlikely, but there are no recent authentic records of red deer on the Queen Charlotte Islands.

The red deer is similar to our well-known wapiti (elk). It is smaller and darker in colour; the males have a large rack of antlers in season; the females lack antlers.

Red deer at one time ranged over much of Europe and Asia. The stock for this introduction probably originated in the British Isles.

Fallow deer.

Fallow Deer

Fallow deer (*Dama dama* L.) were introduced to British Columbia by Irving H. Wheatcroft about 1895. They were released on James Island and became so well established there that periodic control measures had to be adopted. Animals were trapped by the Game Commission on several occasions and released on Saltspring and Pender Islands and in the Alberni district on Vancouver Island. The first transfer was made in 1931; additional animals were released on Saltspring Island and near Alberni in 1934 and 1935 (George Stevenson, 1957).

Fallow deer are now present on James Island, Saltspring Island, and on Sidney Island (J. Todd, 1971). Occasionally an individual swims to adjacent Vancouver and Sidney Islands from James

Island. None has been reported from the Alberni area since 1952, when a single buck was seen. There are no records from Pender Island since 1940.

The fallow deer attains about the same size as the mule deer, but differs in antler form, colour, and in other respects. The antlers, present on bucks only, are palmate (flattened at the upper ends); the pelage varies in colour from white to black but is typically red with light-coloured spots in summer and is uniform greyish-brown in winter. There is no metatarsal gland, as there is in our native deer.

Originally, the fallow deer was found in North Africa and countries surrounding the Mediterranean. Centuries ago it was widely introduced throughout central Europe and to the British Isles.

Domestic Stock

In some sections of the Province, domestic stock has gone wild. These include cats, dogs, goats, cattle, camels, horses, and possibly sheep. It is difficult to delimit, in many cases, where ferality begins or domesticity ends. For example, on some of the larger coastal islands, sheep run at large and are seen many miles from human habitation and control. No doubt some of these animals are never harvested and are truly feral. On the other hand, the sheep-raiser, to protect his sheep, must consider all of them domestic and make such consideration known.

Herds of wild horses were present in the interior of the Province when the white man arrived. They are believed to have originated from stock which was spread northwards by Indians from the region of Santa Fe about 1600, arriving in the Flathead area about 1700 (Haines, 1938). In recent years these animals created range problems in the southern and central grasslands of the Province, which forced cattle-ranchers to destroy many of them. At one time a bounty was placed on wild horses, but despite programmes of eradication small populations still exist.

Domestic cattle abandoned on the west coast of Vancouver Island in the Tofino area established a feral population and were hunted there until about 30 years ago, when the last of them is said to have been killed. Wild cattle are also reported to have

established a small population in the vicinity of Estevan Point and at Cape Scott, but we have no definite information on the present status of these animals.

It is said that feral cattle were numerous along the north and east coasts of Graham Island on the Queen Charlottes, following the early settlements and their abandonment prior to World War I. Northern populations are reported to have disappeared years ago in and around the early 1920's but a population still exists on the east coast. J. W. Maynard of White Rock, British Columbia, reported 18 head in the Cape Ball herd in July 1963, and 40 head at the Oeanda River in August 1962.

In 1862, 22 Bactrian camels were imported to British Columbia to be used in packing supplies during the Cariboo goldrush. They soon proved to be unsatisfactory. A few were returned to the coast for disposal, and the remainder were turned loose, some in the Lac la Hache area and some near Westwold. They were feral in the latter area for several years, the last animal dying about 1905 (*see* British Columbia Archives for details).

Feral cats and dogs are a problem in wilderness areas close to the haunts of man. Dogs have a history in the Province as old as that of man and were present in early native cultures prior to the arrival of the white man. The current habit of abandoning unwanted pets in the wilderness rather than facing the unpleasantness of destroying them has led to the establishment of large feral populations, especially of cats. Even in such remote areas as the Queen Charlottes, wild domestic cats are abundant; such populations have a detrimental effect on native fauna, particularly birds. Cats apparently arrived on this continent with the early white settlers.

Domestic goats are known to be feral on Prevost Island, Saturna Island, Sidney Island, Galiano and Saltspring Islands, and no doubt upon other Gulf Islands long settled by man. Dates of introduction are largely unknown. Feral goats once occurred in the Sooke area and in the Highland District on Vancouver Island.

SECTION II—INTRODUCED BIRDS

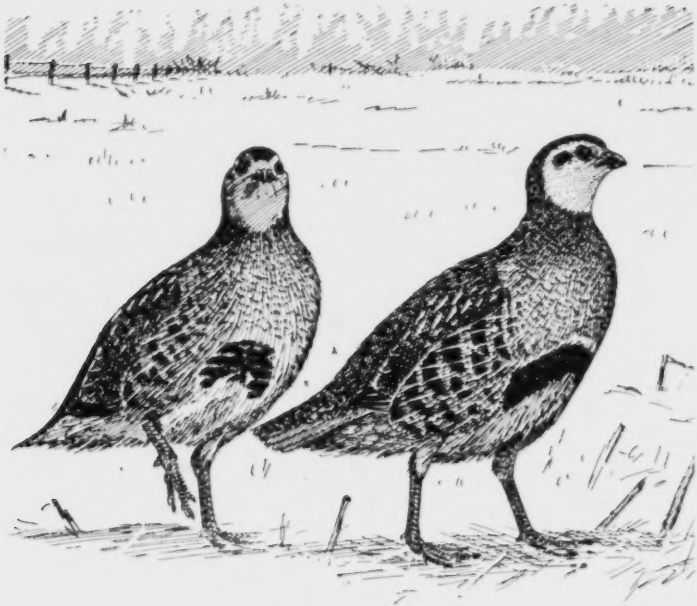
Sage Grouse

Fifty-seven sage grouse (*Centrocercus urophasianus* (Bonaparte)) from Oregon were introduced to the Richter Pass area in 1958 by the Fish and Wildlife Branch. None has been reported since 1960 indicating a complete failure. This species once lived in the extreme southern part of the Okanagan Valley.

Sage grouse.

European Grey Partridge

The European grey partridge (*Perdix perdix* (L.)) commonly known as the Hungarian partridge or "hun," was first introduced to North America sometime prior to 1879. These and subsequent early introductions were made by private individuals in the southern United States. In 1908 and 1909 the species was introduced in southern Alberta, and later in the northern areas around Edmonton. Introductions made in eastern Washington State had, as early as 1917, spread north into the southern Interior of British Columbia and account for the population which established there. Coastal plantings, the first in the Province, were made near Vancouver in



European grey partridge.

March 1904, when 57 "huns" obtained by public subscription were released. Thirty-two were liberated in 1905, 167 in 1907/08, and 277 in 1909. Various numbers were planted in succeeding years, and in 1915 the first open season was allowed. About 500 "huns" were released on Vancouver Island in 1908 and 1909 by J. L. and A. E. Todd, who also planted 72 birds on James Island and 32 on Sidney Island. Also in 1909, A. R. Spalding and H. R. Pooley released 10 birds on South Pender Island.

The present status of the European grey partridge in British Columbia is as follows:

Interior: Extremely abundant in the Okanagan Valley in 1925/26; suffered abrupt decline in 1927 and has since maintained a low population level (Munro

and Cowan, 1947; D. J. Spalding, 1970). Still present in the southern Interior around Osoyoos.

Lower mainland: Small flocks were still present on Sea and Lulu Islands and in the Lower Fraser Valley in 1958. There are no recent records of any remaining in those areas. Two sightings were reported near Boston Bar in 1966. A few sighted along both sides of the Fraser Canyon from Lillooet north to the Empire Valley and possibly to the Gang Ranch area in 1968 and 1969 (B. Gates, 1971).

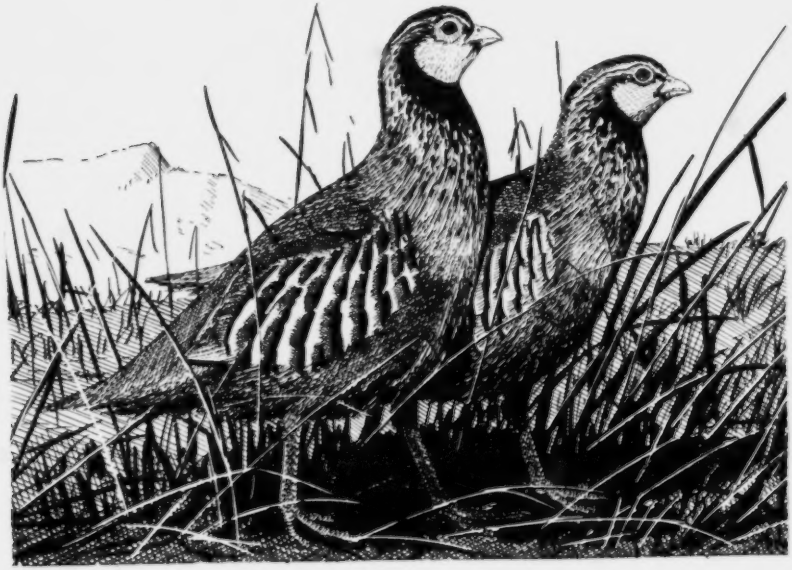
Vancouver Island and Gulf Islands: All of the smaller insular introductions failed after a short while. Two small flocks persisted on Vancouver Island until 1968; one around the Uplands Golf Course area at Victoria, the other at the airport near Sidney. The population at Victoria disappeared in the early 1960's due to housing build-up. A small population still lives around the Victoria airport.

The "hun" is a small grouse-like bird about half again the size of the well-known California quail. It is finely coloured in brown, grey, white, and black. Distinguishing features are a grey breast marked with a distinctive dark chestnut-coloured horseshoe mark.

It is native to Europe and western Asia.

Chukar Partridge

Chukar partridge (*Alectoris graeca* (Meisner) were first introduced to North America (U.S.A.) some time prior to 1934, and to British Columbia at Alkali Lake and Dog Creek in 1940 by A. D. Hitch, of Whonock, British Columbia. Although this early introduction failed, the species was again introduced in 1950, when 17 birds were released by the Game Commission (now Fish and Wildlife Branch) at the Harper Ranch near Kamloops. In 1951, 52 birds were released in the same area, 80 were released near Savona, and 139 near Oliver. Introductions were continued



Chukar partridge.

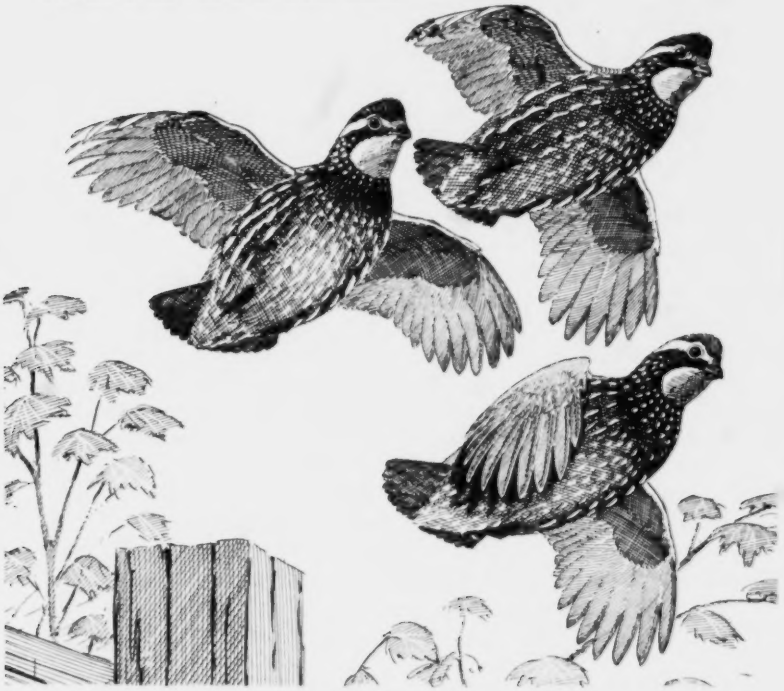
annually until 1956 from stock obtained at Mr. Hitch's game farm at Whonock.

The population increased greatly and spread widely in the release areas and along the Thompson and Fraser Rivers to such an extent that open seasons were initiated in 1955 and have been maintained since. A noticeable decline took place after the winter of 1964/65 resulting in a generally low population. The severe winter of 1968/69 again reduced populations, but coveys are still present in many areas (R. W. Ritcey, D. J. Spalding 1970).

The chukar is a beautiful, easily recognized bird. It measures about 12 inches long, and male and female have similar coloration. It is white on the throat, pearl grey to reddish-buff below. A distinctive black necklace curves up below the eye. Above it is soft

greyish-brown, with strongly barred flanks which furnish positive identification even at a distance.

Chukars are native to northern China, Mongolia, India, Persia, Arabian Asia Minor, and southern Europe. Several subspecies occur; that introduced to this Province is believed to be the Northern Hill Chukar from India.



Bob-white quail.

Bob-white Quail

According to Game Department records, bob-white quail (*Colinus virginianus* (L)) were first introduced to British Colum-

bia to points on the lower mainland. One hundred and fifty-six birds were released. One hundred and thirty were released near Ashcroft in 1900, 32 near Shuswap in 1905, and 35 at the Coldstream Ranch near Vernon in 1907. In 1922 additional birds were released on Vancouver Island. The species is said to have been present on Pender Island in 1882, and disappeared about the turn of the century, but we have no official record of this introduction.

Present status of the bob-white in British Columbia: Said to have done well for a period of years in the southern Interior, but the latest authentic record for that area is listed as January 1912, by Munro and Cowan (1947). Several flocks survived near Huntingdon on the U.S. boundary, but were exterminated in the severe winter of 1947/48. Nick Milani of Ladner released some bob-whites on his property in 1967 or '68 and has since observed successful reproduction. Two coveys were noted in December 1969 (B. Gates, 1970). Twenty birds released at the Reifel Waterfowl Refuge in the spring of 1971 apparently perished the following winter (Campbell, 1971).

The bob-white is a small plump partridge, smaller than the California quail. It is pinkish-brown in colour, mottled, and lined with dark-brown patches and buffy lines. The flanks are heavily streaked with white, and broad white line extends through the eye to the back of the head. The throat is white, bordered in black.

Bob-white ranged originally from southeastern Canada through the eastern United States and across the south into Mexico. Its range increased as agricultural pursuits spread across the continent. It is represented on its range by several subspecies.

California Quail

California quail (*Lophortyx californica* (Shaw and Nodder)) were first introduced to British Columbia in 1860 or 1861 by Charles Wylde, a resident of Victoria, who released them in the vicinity of that city (Wylde, 1923). About the same time H. M. Peers of Colquitz Farm released "a lot" of birds obtained from a D. Warbass of San Juan Island. Later, in the 1870's, the species

California quail.

was again introduced to the same areas by Simon Tolmie, Colonel Pendergast, Major Gillingham, and others. In the 1890's further introductions (no details available) were made on southern Vancouver Island and the lower mainland. In 1908 and 1910 introductions were made near Nicola in the southern Interior and on the Queen Charlotte Islands. Between 1907 and 1909 A. R. Spalding and H. R. Pooley released 30 birds on South Pender Island. Birds introduced to northern Washington about the same time are believed to have spread northwards through the Osoyoos area, and with the Nicola birds populated the southern Interior of the Province (Munro and Cowan, 1947).

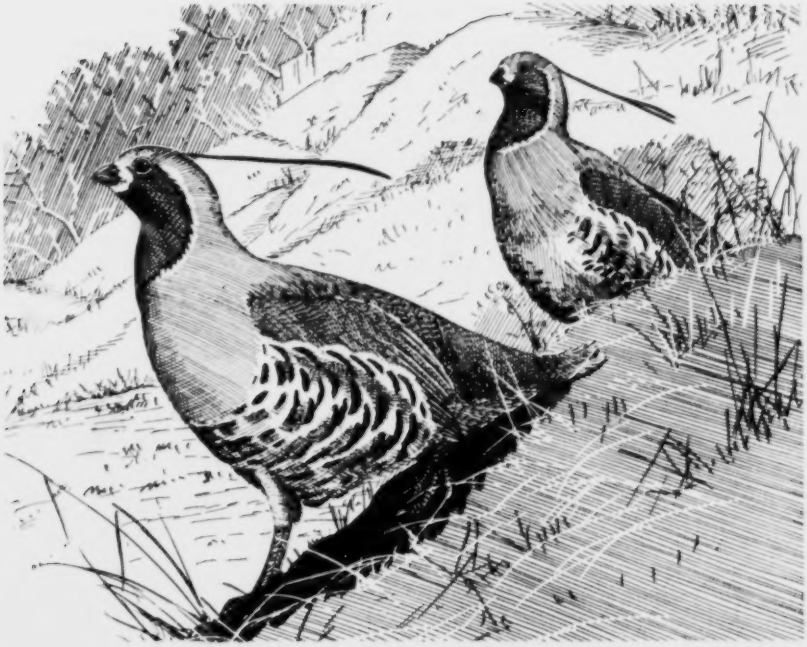
Present status of the California quail in British Columbia: Well established on Vancouver Island, mainly in the Saanich Peninsula, Victoria, and Sooke areas, occurring sporadically north at least to Comox. It varies in numbers from year to year, but populations are now relatively low after many years of abundance following the introductions. A few birds are still present on Pender Island. Lower mainland introductions were not successful, although small numbers still maintain themselves there, especially in the vicinity of Tsawwassen, Centennial Beach, and Beach Grove (B. Gates, 1970). Established and maintaining small numbers throughout the southern Interior. Population numbers vary greatly from year to year depending upon favourable or unfavourable climatic and grazing conditions. Queen Charlotte Island introductions were unsuccessful, as were introductions in the Vanderhoof area.

The California quail is a small partridge about 10½ inches (26.6 cm.) long, plump, with an olive-grey back blending to soft shades of brown on the wing and flank, the latter streaked with white. The breast is clear blue-grey; the abdomen is feathered in black and cream to give a scaled appearance. The head of the made is adorned with a scimitar-shaped plume which leans forward from the top of the head. The throat is black, clearly delineated by a white border. Females are duller, with head plume less pronounced.

This species is native to western Oregon and California; it has been introduced to many parts of the United States, Canada, New Zealand, the Hawaiian Islands, Chile, and other countries.

Mountain Quail

Mountain quail (*Oreortyx picta* (Douglas)) were first introduced to British Columbia at Victoria in 1860 or 1861 by Charles Wylde, at the time he released California quail (Wylde, 1923). At the same time, introductions were being made in Washington, on San Juan Island, and on Whidbey and other islands on the American side. Birds are said to have been released in the Fraser Valley also at this time. These early introductions apparently failed, but later, stock said to have been released in the 1870's and 1880's "took" on Vancouver Island, and a population was established. The



Mountain quail.

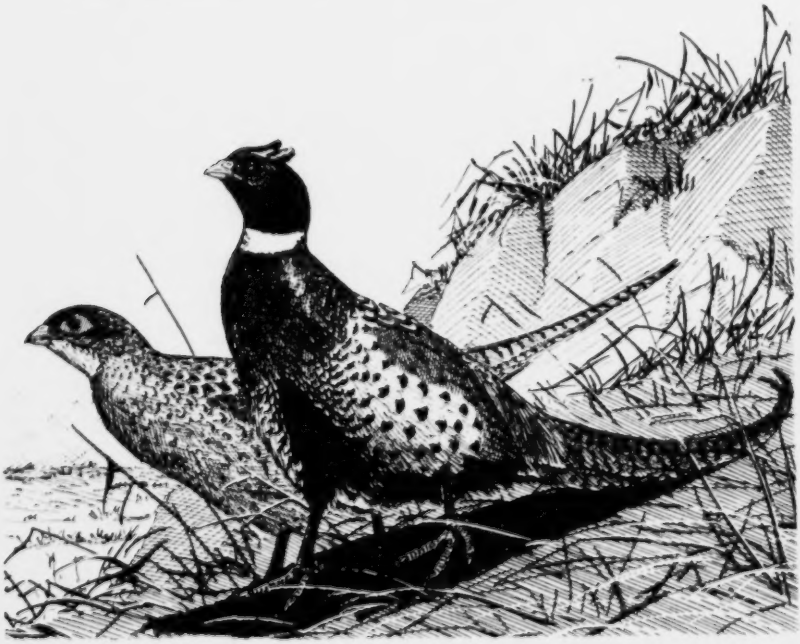
birds were confined to the southern end of the island, and from reports of old-time hunters it appears that they were fairly numerous in certain areas, although never so abundant as the California quail.

Present status of the mountain quail in British Columbia: Small numbers in the Highland District (Durrance Lake, Wark Mountain, Todd Inlet) near Victoria and occasionally reported from the Malahat in the vicinity of Spectacle Lake. They are reported to nest in the vicinity of Cabin Pond on the Goldstream watershed. Small numbers are also reported occasionally from Mount Sicker and Herd Road near Duncan. There are records of

the species from Vedder Mountain in 1921, but, to our knowledge, no authentic reports have been received from the Fraser Valley since that time. In January 1969 a flock of eight mountain quail was drowned, landing on floating snow in Todd Inlet.

The mountain quail differs from the California in being slightly larger and in having a long straight plume running back from the top of the head. The throat patch is brown rather than black, and the flanks are barred in brown and white.

These birds originally occupied a range extending along the humid west coast of the United States from northwestern Oregon south to Monterey County in California.



Ring-neck pheasant.

Ring-neck Pheasant

Ring-neck pheasants (*Phasianus colchicus* Gmelin) were first introduced to British Columbia by C. W. R. Thompson, of Victoria in 1882. Twenty birds arrived from England, but all died. The following year Mr. Thompson released, at Esquimalt, 25 birds that were obtained from China; these survived and did well. In 1886 Edward Musgrave released 12 Chinese birds on Saltspring Island; in 1890, 20 were obtained from the same country and released on Prevost Island. In 1890 the Mainland Protective Association released 20 pheasants at Point Grey, and in 1893, 23 birds were released at Ladner. Between 1890 and 1900 introductions, numbering 82 birds, were made in the Province, some to Pender Island. In 1910 the Game Commission took over the breeding and the releasing of pheasants. Thousands of birds were released annually at strategic hunting areas within the Province until 1954 when the practice was discontinued. Raising of pheasants at the Government game farm in Saanich was discontinued in 1933 (George Ferguson, 1970). Subsidizing thereafter was done with birds purchased from commercial pheasant breeders. Experimental releases were made during this period on the Queen Charlotte Islands and in the Vanderhoof area. Both failed after a short period.

This bird is so well known that description here is unnecessary.

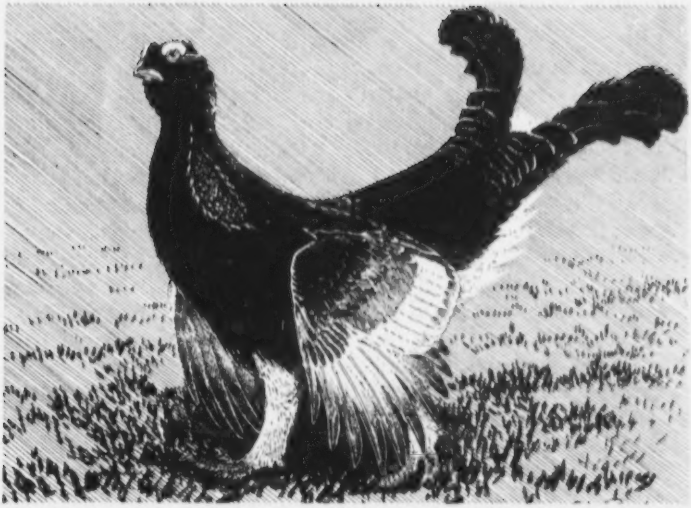
The species is native to Asia, extending as three subspecies westward to Europe. It was introduced to the British Isles.

Black Game

Black game (*Lyrurus tetrix* L.) were introduced to British Columbia in 1906 by a Mr. Chaldecott and Mr. Musgrave, when 19 birds were released on Vancouver Island and adjacent islands, and 16 were released near Nicomen on the mainland. The stock originated from Copenhagen, Denmark.

Present status of black game in British Columbia: The introductions were unsuccessful, and this species does not occur within the Province now.

The black game, or black cock, is a dark, handsome grouse about the size of our blue grouse. Males have black plumage and



Black game.

a peculiarly shaped tail, in which the feathers flare outwards. Females are grey and are commonly termed "grey hen." The black game is said to hybridize with capercaillie, red grouse, and other gallinaceous birds.

This species is native to Europe and Asia, inhabiting pine and birch forests surrounding open moors.

Capercaillie

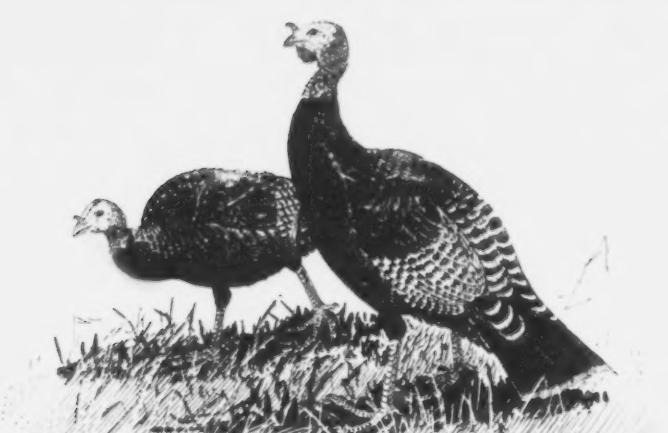
In 1906, 14 capercaillie (*Tetrao urogallus* L.) were released near Cowichan Lake on Vancouver Island, and eight were liberated near Lake Bunsen on the mainland. Stock was obtained from Denmark and released by Mr. Chaldecott and Mr. Musgrave.

Present status in British Columbia: These introductions failed, and the capercaillie does not occur in British Columbia now.

This species is a very large tree-loving grouse, somewhat resembling the blue grouse but much larger. It is native to the pine forests of northern and central Europe and Asia.

It was once indigenous to northern Scotland and Ireland, but was exterminated there in the late 1700's. It was reintroduced to Scotland in 1837 and still occurs there.

Capercaillie.



Wild turkey.

Wild Turkey

Two pairs of wild turkey (*Meleagris gallopavo* L.) were intro duced to James Island in 1910 by Sir Richard McBride and a grou of associates who had purchased the island for purposes of huntin According to former Game Inspector, the late George Stevenso the birds multiplied and were fairly numerous for a number years but had all disappeared by 1929. Two hundred birds Virginia stock are said to have been raised on the Game Com mission's farm (the game farm in Saanich was discontinued as a operational breeding station in 1933). It and the land surroundin were retained as a Provincial game reserve with a residence for th local game warden. It was totally discontinued on the Saanic Peninsula in 1954 (G. Ferguson, 1970). Former Game Warde Joseph Jones, reports that some 30 to 40 of these birds we released on Sidney Island; others on Prevost Island. Game Wa den, L. H. Walker, released about a dozen birds on South Pend

Island in 1931. None of these introductions was successful and no wild turkeys existed in British Columbia until Jack Todd re-introduced them to Sidney Island. A small protected population now exists from 12 birds released in 1962. A 1961 introduction of 10 birds failed.

The wild turkey resembled the well-known domestic barnyard fowl, which was originally developed from wild turkey stock. It is an important game bird in the United States where it has been introduced widely in areas where it did not formerly occur. Two such areas immediately south of the Kootenays account for reports of wild turkey in those regions of British Columbia (Demarchi, 1967) (Merilees, 1971).

(Apart from the Provincial Marine Park on Sidney Spit, both James and Sidney Islands are private property, posted against trespass and shooting.)

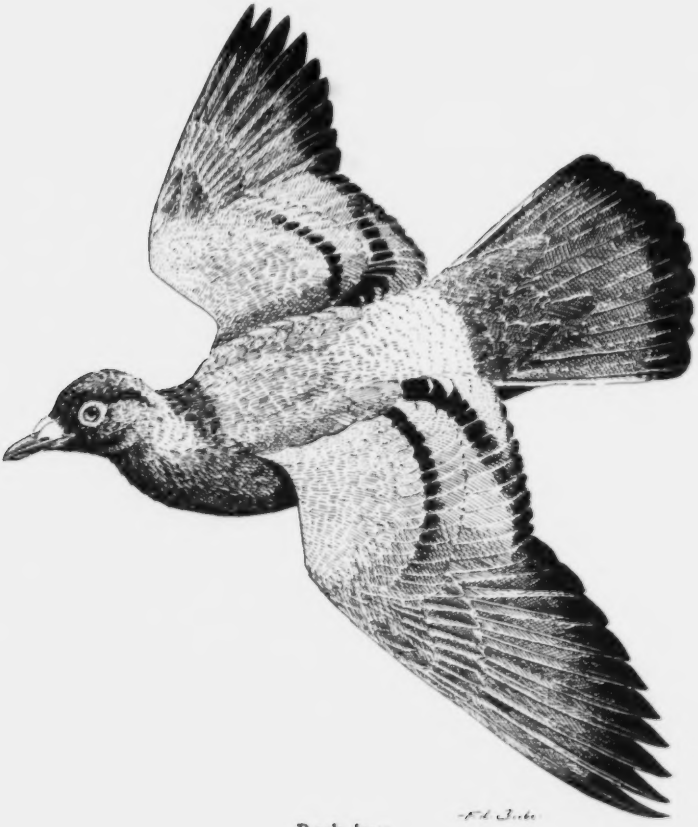
Rock Dove

The European rock dove or domestic pigeon (*Columba livia* Gmelin) was first brought to Canada by Lescarbot in 1606/07 (Saunders, 1935), and no doubt many other introductions followed.

The rock dove is well established across the continent, mainly around centres of human habitation. In parts of central Washington and possibly in other States, the rock dove is completely feral, living and nesting in areas far from settlements. In British Columbia no free-living colonies were known outside of settlements until May 1966 when a museum field party recorded rock doves nesting in the cliffs along the east side of the Okanagan Valley from Osoyoos to Vaseux Lake.

Present status in British Columbia is as stated above.

Because of much intermixing in wild birds, many types of plumage may be found in any population. The ancestral form is distinguished by the presence of the dark parallel wing bars, light rump patch, iridescent neck feathers, naked eye-ring, and other features as shown in the illustration; and some of these characteristics are usually evident in each individual.



Rock dove.

English Skylark

In the fall of 1903, 100 pairs of skylarks (*Alauda arvensis* L.) were released near Victoria by the Natural History Society of British Columbia; in 1913 an additional 49 birds were liberated in

English skylark.

the same areas. Others are said to have been released about the same time on the lower mainland at the mouth of the Fraser River (Brooks and Swarth, 1925). Prior to this, in 1908 or 1910 a G. H. Wallace is said to have imported a number of skylarks, along with other British birds which included red breasts, blue tits, linnets, and goldfinches. These were apparently released at various points on the Saanich Peninsula. None but the skylarks survived. In 1919 a Mrs. E. A. Morton is said to have released five imported skylarks at Oak Bay.

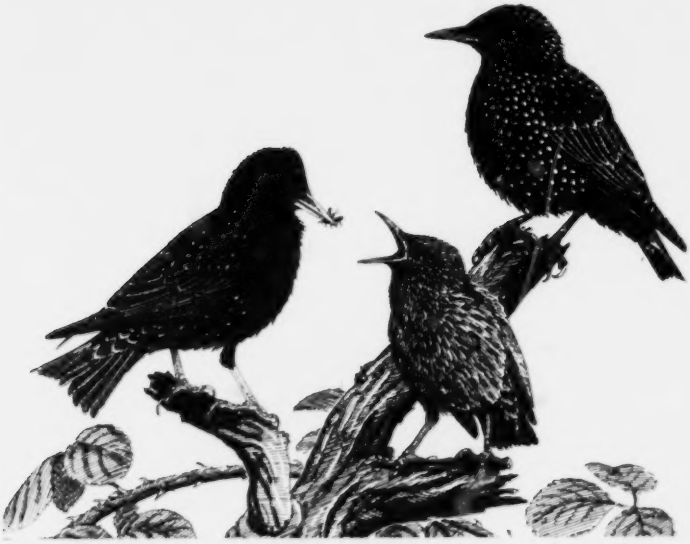
Present status in British Columbia: Established in suitable grasslands in the vicinity of Victoria, on the Saanich Peninsula, and sometimes on Sidney Island. Much of the habitat occupied by the skylark was usurped by housing and other projects in the 1960's with a subsequent population decline. At present small populations occur around the University of Victoria campus, the Rithet Estate, around the airport, along the east side of the McHugh Valley and at other points on the Saanich Peninsula, and in the vicinity of Duncan.

The skylark is intermediate in size between the house sparrow and the robin. It is pale brown above, irregularly marked with darker streaks. Below, it is white to buff in colour, with a white throat and breast streaked in brown. The outer pair of tail feathers is white. The hind toe has an elongated nail.

It ranges principally in temperate Europe and Siberia. The species introduced to British Columbia is native to the British Isles.

European Starling

The European starling (*Sturnus vulgaris* L.) was first introduced to North America in 1890 and 1891 at Central Park in New York City. Since that time it has gradually spread north, south, and west throughout most of the United States and Canada. It was first recorded in British Columbia at Oliver in 1947. By 1953 it was breeding throughout the southern Interior and sparsely on the mainland coast and Vancouver Island, having reached the Queen Charlotte Islands as well. At the close of the 1960's the European starling is a common nesting bird throughout the Prov-



European starling.

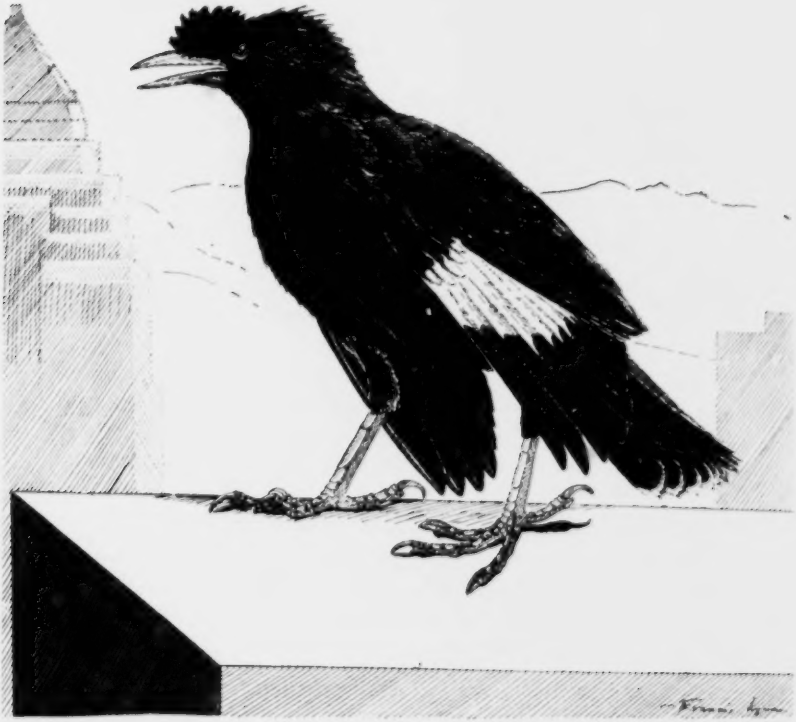
ince. Large wintering concentrations are commonly seen in many areas. On February 25, 1970, three scattered flocks observed at Burnside and Douglas in Victoria numbered over 3,000 birds. Larger concentrations are reported from the lower mainland.

Present status in British Columbia is as stated above.

The European starling resembles a blackbird, but with a shorter tail and light-coloured feet. The dark plumage has an iridescent sheen, and in the winter and spring is speckled with fawn-coloured markings; the bill is dark at this time. In summer the fawn-coloured markings are retained on the back only, having largely disappeared from the breast and flanks; the bill is yellow when the bird is in summer plumage.

The European starling is regarded as a serious pest, particularly in urban areas where the droppings and nesting material

deface buildings. In agricultural areas it can be destructive to grain and fruit crops. It is said to compete with native songbirds for nesting sites and range. All in all, it is an unwelcome addition to the North American fauna, and, like the house sparrow, it provides a classic example of the danger of introducing exotics. As the name implies, this bird is native to Europe.



Crested mynah.

Crested Mynah

This bird, commonly called the Japanese starling (*Acridotheres cristatellus* (L.)), apparently arrived on coastal British Columbia around the turn of the century. It was believed to have been introduced by Oriental immigrants living at Vancouver, or to have arrived accidentally aboard ships (Munro, 1922). The first authentic report came to the attention of the Provincial Museum in 1897, when two pairs were reported in the City of Vancouver. In 1904 specimens were taken in that city by the Museum, but were reported scarce at that time. Between 1904 and 1920 the population within the city increased rapidly, and the birds were common there during the 1930's.

Present status in British Columbia: Confined largely to the Vancouver area, where populations within the city have declined. Birds are now seen largely in rural areas around Vancouver City and New Westminster. There are a few records from Victoria, Nanaimo, and Courtenay on Vancouver Island.

This bird is about the size of a robin, black throughout with a white patch on the wing. It carries a low crest on the forward part of the head.

The crested mynah is native to Asia.

House Sparrow

According to Barrows (1889), the house sparrow (*Passer domesticus* (L.)) was first introduced to North America at Brooklyn, New York, in the fall of 1850 by the Brooklyn Institute, ostensibly to control insect pests. Many other introductions followed, the largest in 1869, when 1,000 birds were brought from Europe and released in Philadelphia by the civic authorities. Between 1850 and 1881 about 1,600 birds were introduced directly from England, most of them released in the eastern United States. During this same period, stock from established sparrow populations in the eastern States was transferred to many parts of the United States and eastern Canada. The spread of this species in both area and numbers was phenomenal. For example, in Ohio in October 1887, Charles Drury reported one flock near Ross Lake

House sparrow.

composed of tens of thousands of birds. So plentiful did it become that bounties were paid in some sections, and the birds appeared on the market for sale as food. We can find no record of the date of arrival of this bird in British Columbia, but as it was well established in California and northern Utah by 1886, it seems logical to assume that the house sparrow invaded this Province within a few years of that date.

Present status in British Columbia: Common in settled areas throughout the Province, less common in northern areas. The population has become stabilized at a level far below that recorded for the early part of the century.

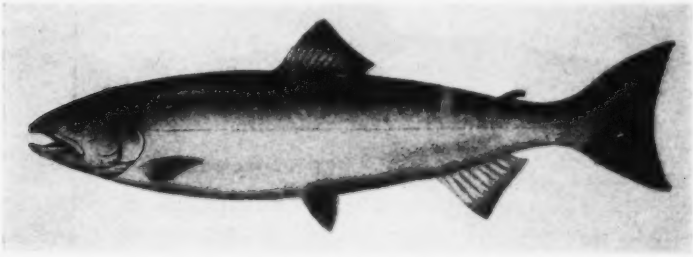
This bird is so well known that the illustration suffices for description.

The original range included most of Europe and the British Isles; birds from the latter area account for the name English sparrow.

SECTION III—INTRODUCED FISHES, FROGS, AND TURTLE

Atlantic Salmon

Atlantic salmon (*Salmo salar* L.) were first introduced into British Columbia in 1905, when 90,000 fry were released into Coquitlam River, Lillooet River, and Harrison Lake on the mainland, and into Campbell River, Comox Lake, Horne Lake, Nanaimo Lake, Cowichan Lake, and Koksilah River on Vancouver Island. In subsequent years more plantings were made in other bodies of water, particularly into the Cowichan system, which was then judged to be the most suitable for these species. For these introductions, which were continued until 1933, eggs were imported from the Canadian Atlantic coast as well as direct from Scotland.



Atlantic salmon.

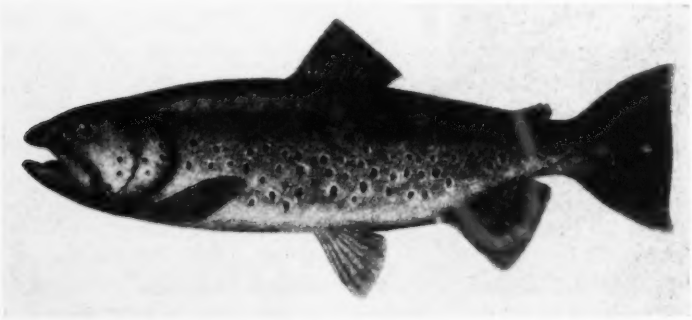
There appear to be only three authentic records of Atlantic salmon being taken by anglers, all small fish, and none since 1926. The introductions have obviously been failures. (*See* Carl and Clements, 1953; Dymond, 1955.)

The Atlantic salmon is most like a steelhead in appearance. It differs in having only nine rays usually in the anal fin (10 or 11 usually in steelhead) and in having scattered rounded or X-shaped spots on the sides. Any fish suspected as being of this species should be examined by an expert.

The natural range of the Atlantic salmon is the North Atlantic Ocean, ascending suitable rivers in northern Europe, and the region north of Cape Cod to Hudson Bay in North America.

Brown Trout

Brown trout (*Salmo trutta* L.) were introduced into British Columbia largely as the result of pressure put upon the Federal Fisheries Department by persons interested in improving angling in coastal rivers during the off-season. Reasoning that since the native trout of Europe remain in their streams all year around, advocates suggested that these fish would provide a sport fishery in British Columbia during the summer months when native fish are usually absent or difficult to catch.



Brown trout.

Accordingly, in response to repeated requests, 20,275 fry and 239,858 fingerlings and older fish were planted in the Cowichan River system during the years 1932 to 1935, and during the same period 163,786 fry and 123,577 fingerlings and yearlings were released in the Little Qualicum system (Neave and Carl, 1949). Both river systems are on the east coast of Vancouver Island, and both include a lake and numerous tributaries.

In both cases the plantings were successful, inasmuch as brown trout became established and have persisted. The first natural

spawning run observed in the Cowichan system took place in 1937, when 22 females and 14 males were taken in traps in tributary streams near the old Cowichan Lake hatchery (Carl, 1939). A run of fish in spawning condition was observed in the Little Qualicum in early 1937; in 1939 a spent trout was taken; and in June 1939, a 5-inch fingerling was caught and released; specimens were netted in Cameron Lake in the early 1950's by Fish and Wildlife Branch, lake survey crews (Northcote, 1970), and are now taken in that lake and in the Cameron River and Pipeline Creek by sportsmen (Lyons, 1970).

In the Cowichan system, brown trout are present in the portion of the river above Skutz Falls, although they are not numerous in relation to the native trouts. They have been taken in the tidal portions of both rivers right down to the sea, but the only evidence of salt-water entry is provided by one individual taken in Niagara Creek near Goldstream (Malahat) in 1952, about 15 miles south of the Cowichan River mouth.

Brown trout have been introduced to the Kettle River System by the Fish and Wildlife Branch and are pending introduction to the Similkameen River (Northcote, 1970). Specimens taken in the Columbia River at Castlegar apparently originate from introductions in the United States (Andrusak, 1970).

Brown trout are usually readily recognized by the general golden-brown ground colour with dark-brown or black spots on body, dorsal, adipose, and tail fin. Some body spots are edged with orange, and some below the lateral line may have halos of pink on red. Fish in salt water or recently arrived from the sea are more silvery in appearance and may lack the spots.

The natural range of brown trout is from Iceland and the northern part of Norway, south to the Bay of Biscay, ascending all suitable streams to breed.

Speckled Char

Since 1960 the speckled char (*Salvelinus fontinalis* (Mitchill)) has been widely introduced to many lakes and streams in British Columbia by the Fish and Wildlife Branch (Vernon, 1971).

"Hatchery plantings have been extensive in the East Kootenay, and Central Interior districts (Prince George, Williams Lake, Kamloops) where it seems to survive over the winter in shallow lakes which could not maintain rainbow trout populations" (Northcote, 1970).

Details on localities stocked may be obtained from resident regional fisheries biologists.

Early introductions prior to 1917 were made on the mainland in the Okanagan Valley and in the Keremeos area. On Vancouver Island the species was also introduced early to the Cowichan system, Spectacle Lake, Somenos Lake, and Round Lake near Duncan (Carl and Clemens, 1953).

Speckled char.

The natural range of this fish is northeastern North America, where it thrives best in clear lakes and cold streams. It was first introduced in British Columbia some time prior to 1917 in the form of fry released from the Gerrard Hatchery at Trout Lake in the Kootenay District.

The speckled char or brook "trout" may be recognized by the presence of dark-green worm-like markings on the back and on the dorsal fin. The sides also bear small greenish spots, some with red centres bordered with blue, and the lower fins are usually edged with white on the front margin.

American Shad

Atlantic Coast shad (*Alosa sapidissima* (Wilson)) were first introduced on the Pacific Coast between 1871 and 1880, when 621,000 fry were released in the Sacramento River, and further lots, amounting to 910,000 fry, were planted in the Columbia system in 1885/86 (Neave, 1954). A fisheries of some importance developed on the Columbia by 1888, and the species was first reported as occurring in British Columbia in 1891 when a full-grown specimen was taken in the Fraser River (Carl and Clemens, 1953). The following year several shad were taken at Rivers Inlet, about 250 miles north of the Fraser. Since that time shad had been taken occasionally in these and other localities in British Columbia, and north as far as Cook Inlet, Alaska. Lately the number taken near the mouth of the Fraser has increased, but there is little indication that this species will ever become of commercial importance in this Province.

American shad.

Shad are herring-like fishes with silvery-white on sides and belly and bluish on the back. Round black spots in a row on the side of the body are conspicuous, especially when scales are removed. The upper jaw is notched at the tip; the scales on the belly are strongly keeled. Shad may attain a length of 75 cm. (30 inches).

The shad is native to the Atlantic Coast of North America, from the Miramichi to the Alabama, ascending rivers in spring to spawn.

Striped Bass

Striped bass (*Morone sexatilis* (Waldbaum)) introduced to the Pacific coast in 1879 and 1882 near the Sacramento River delta of California, in 20 years had spread northward to southern Oregon and the mouth of the Columbia River. It was recorded in Puget Sound in 1968.

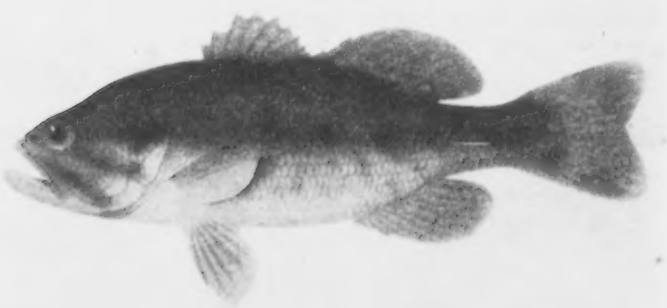
Striped bass.

Two specimens taken in 1971 are the first records for British Columbia waters (Forrester, Peden, and Wilson, 1971). The first, taken by gillnet in Barkley Sound by J. D. Kendrew in July was salvaged and presented to the Provincial Museum by Leonard Jennings of Bamfield. The second specimen, taken in August off Port San Juan, Vancouver Island, by John Toyodo, of the gillnetter *Canada 101* was sent to the University of British Columbia.

The striped bass is dark olive-green above, varying to blue and black, paling on the sides to silver, and white on the belly. Sides

bear seven or eight more or less prominent horizontal dark stripes. The shape is typically bass-like. A specimen measuring 6 feet (1.82 metres) in length and weighing 125 lb. (56.8 kg.) was recorded in the Atlantic (Lerin and Scott, 1966).

The striped bass lives in the ocean close to shore, ascending suitable fresh water rivers to spawn. It is an important food and game fish where abundant.



Largemouth bass.

Largemouth Bass

Bass of this species (*Micropterus salmoides* (Lacepede)) are found in Vaseux, Osoyoos, Christina, Duck, and Kootenay Lakes, all part of the Columbia system. They were first brought to the Northwest in 1890, 1891, 1893, and 1895, when they were widely planted in Oregon and Washington by the United States Bureau of Fisheries (Smith, 1896). The Kootenay Lake bass probably originated from fish that escaped from private ponds into the Kootenay River at Bonners Ferry, Idaho, in 1916 (Dymond, 1936). According to Dymond, largemouth bass were taken for the first time near Kootenay Landing in 1912, and they had spread to Pilot Bay by 1928. Those in Osoyoos and Vaseux Lakes probably gained access by way of the Okanagan River from the

south. The species is also present in Shannon Lake near Kelowna (Northcote, 1970).

The natural range of the largemouth bass is Manitoba east to Quebec, through the Great Lakes region and Mississippi Valley to northeastern Mexico and Florida, and north along the coastal plain to North Carolina.

It can be distinguished from its cousin, the smallmouth bass, by the larger mouth, extending in the closed position to a point behind the margin of the eye, and by the notch which almost divides the dorsal fin into two parts.

Smallmouth bass.

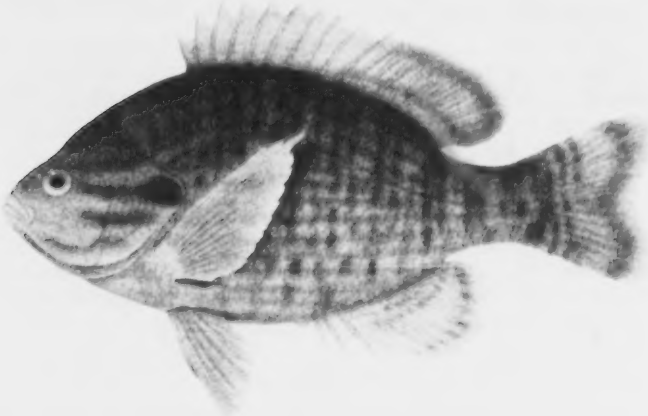
Smallmouth Bass

Smallmouth bass (*Micropterus dolomieui* Lacepede) are known to occur in the following British Columbia lakes: Christina and Boldue (Columbia system); Florence, Langford, Beaver, Elk, Prospect, Durrance, Lost, Matheson, Young, and Glen Lakes; Spider (north of Nanaimo); St. Mary (Saltspring Island). They are also reported to be present in Wasa Lake (near Kimberley), Moyie Lake (south of Cranbrook), and Mirror Lake (south of Kaslo).

The natural range of the species is northern Minnesota to Quebec and south to the Tennessee system of Alabama and to eastern Oklahoma.

Smallmouth bass were first brought to British Columbia as fry or fingerlings in 1901 and were planted in Christina Lake on the mainland and in Langford and Florence Lakes on Vancouver Island. In 1920 a few fish were removed from Langford Lake and released in St. Mary Lake, Saltspring Island; three years later, specimens were transferred from Florence Lake to Spider Lake. The other lakes now containing this species were probably subsequently stocked from these sources.

The smallmouth bass is likely to be confused only with the largemouth, from which it may be separated by the smaller mouth (not reaching the hind margin of the eye) and by the undivided dorsal fin (the notch is incomplete).



Pumpkinseed or sunfish.

PUMPKINSEED OR SUNFISH

Within the Province, pumpkinseeds (*Lepomis gibbosus* (Linnæus)) are present in Christina Lake, Kootenay Lake, Wasa Lake, Boldue Lake, Osoyoos Lake, Vaseux Lake, and in oxbows of the

Okanagan River between the latter two lakes. On Vancouver Island they now occur in Beaver, Elk, Prospect, Langford, Blenkinsop (Swan), Glen, Glintz, Young, Quennel, Holden, Michael, and possibly some other small lakes. They are also found in Colquitz Creek, draining Beaver and Elk Lakes, and in the Somass River system near Alberni.

There appears to be no authoritative record of the introduction of this fish into the Northwest. Lampman (1949) states that adult largemouth bass and small fry of "various sunfish" were released into the Willamette River in 1893 by the United States Fish Commission, and it is assumed that pumpkinseeds were included. In any case they became widespread in Oregon and Washington at a fairly early date, and it is possible that those in the mainland lakes of British Columbia originated from this source by natural spread up the Columbia River and its tributaries.

On the other hand, it has been suggested that pumpkinseeds were introduced accidentally into the British Columbia lakes along with black bass fry. This seems the most likely explanation for their presence on Vancouver Island, where they are found in lakes that also contain smallmouth bass.

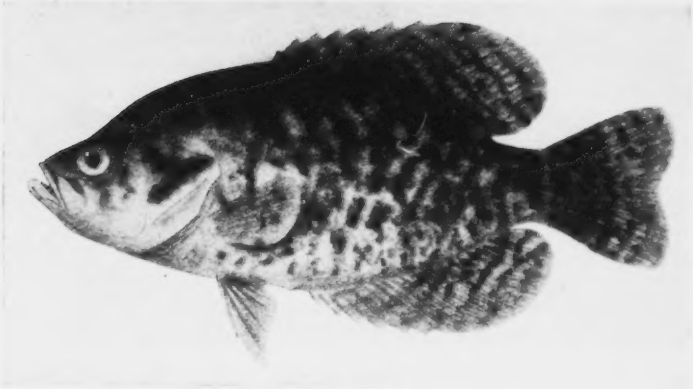
The natural range is central and eastern North America.

The pumpkinseed is readily recognized by its "sunfish shape" and bright colours. Adults are greenish-olive or bluish-olive above, with the sides spotted with orange. The cheeks are orange with wavy blue streaks and a bright scarlet spot on the lower edge of the gill-cover lobe.

Black Crappie

Crappies (*Pomoxis nigromaculatus* (LeSueur)) were first noted in British Columbia in Hatzic Lake in 1933 (Hart, 1934), and since that time they have been discovered in many other lakes and backwaters connected with the lower Fraser system.

Black crappies and their cousins, the white crappies (*Pomoxis annularis*), are widely spread in Washington and Oregon, where they were first released in 1890 and 1892. No record is available as to how black crappies reached British Columbia, but it is



Black crappie.

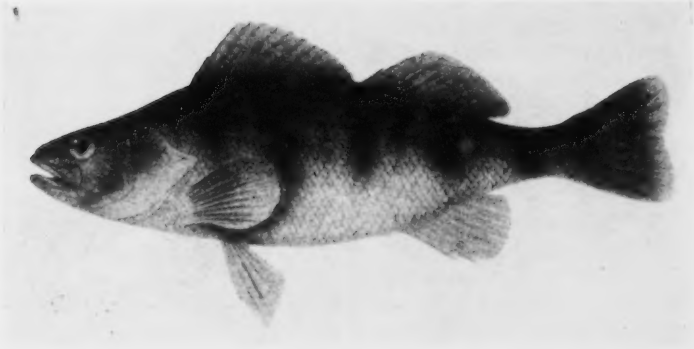
assumed that they were the result of transplantation, probably from Washington, the nearest source.

The natural range of this fish is eastern and central North America south to northern Florida.

The crappie has a larger mouth than the pumpkinseed and lacks the bright colours of the latter. The general colour is silvery-olive mottled with olive-green, the mottlings on the dorsal, anal, and tail fins arranged somewhat in rows. The gill cover is decorated with an irregular dusky spot.

Yellow Perch

Perch (*Perca fluviatilus* (Mitchill)) in British Columbia are confined to Osoyoos, Vaseux, Gallagher, and possibly other lakes of the Okanagan system including a small pond east of the highway and just south of Gallagher Lake. They are also reported from Lush Lake near the Keremeos highway, and in Shannon Lake, near Westbank. They probably originated from Washington, where the species was first introduced in 1890, and where it is now widely distributed. Yellow perch were introduced to Charlie



Yellow perch.

and Swan Lakes in the Peace River district in 1970 by the Fish and Wildlife Branch. The natural range is eastern North America from Hudson Bay to Kansas.

Perch may be identified by the presence of two dorsal fins (the first spiny) and rough scales. The colour is yellowish, with six or eight broad cross-bars extending from the back to below the middle of the sides.

Brown Catfish or Brown Bullhead

Catfish (*Ictalurus nebulosus* (LeSueur)) are found in many lakes and streams of the lower Fraser system on the mainland of British Columbia and in a number of lakes on southern Vancouver Island (Carl and Clemens, 1953). They are also widely spread throughout most of the Pacific Coast states, but the details of their introduction are not known. Catfish were recorded from Silver Lake, Cowlitz County, Washington, as early as 1888 (Smith, 1896), but were undoubtedly planted there some years previous to that date (Lampman, 1949). Fish escaping via the outlet to the Columbia probably were the ancestors of those now found in the lowland waters of Washington and Oregon, though other plantings were also made.

How and when catfish arrived in the lower Fraser system of British Columbia is unknown, but those on Vancouver Island apparently owe their origin to the late H. E. Levy, of Victoria, who is said to have imported live specimens in 1906 from Portland, Oregon, for display in a tank in his restaurant. A few of these live fish were subsequently given to a man by the name of Clark, who planted them in Beaver Lake, a few miles north of Victoria, by throwing them from the window of the train which in those days operated between Victoria and Sidney. About the same time, others were placed in Langford Lake, about 16 kilometres (10 miles) northwest of Victoria. The other bodies of water on Vancouver Island in which catfish are now found probably were stocked with fish taken from either of these two sources (Carl and Clemens, 1953).

Brown catfish or brown bullhead.

The brown catfish is easily recognized by its prominent barbels or whiskers around the mouth. It lacks the light bar found at the base of the tail fin in the black catfish, and is much slimmer in build.

The natural range is the Great Lakes, Ohio Valley, eastward to Maine, southwestward to Texas, and southeastward to Florida.

Black Catfish or Black Bullhead

In British Columbia the black catfish (*Ictalurus melas melas* (*Rafinesque*)) is known only from Osoyoos Lake, where it was

first collected in 1941 (Carl, 1945). Earlier reports of this fish were apparently based on the brown catfish, which is widely spread in the coastal area.

The black catfish was recorded from the State of Washington in the Columbia River as early as 1895 (Smith, 1896) but is not otherwise noted in the literature (Chapman, 1942). It must have entered British Columbia by way of the Okanagan River, a tributary of the Columbia.

Its natural range is North Dakota, east through the Great Lakes drainage, south and westward to Pennsylvania, Tennessee, Kansas, Wyoming, and Colorado.

Black catfish or black bullhead.

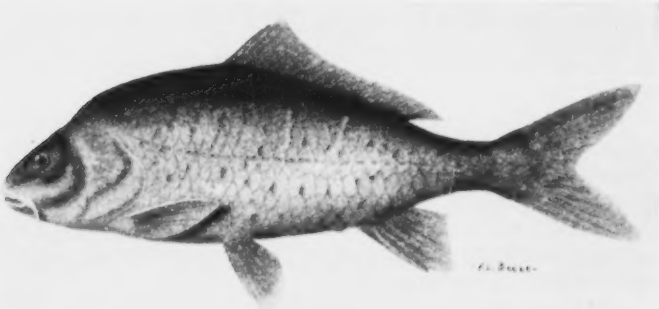
It is distinguished from its cousin, the brown catfish, by its heavier build, darker coloration (almost black) with greenish to yellowish or golden underparts, and the presence of a light bar across the base of the tail fin. A catfish, unidentified as to species, was recently found in Kootenay Lake.

Carp

Carp (*Cyprinus carpio* L.) were brought to North America as early as 1831 (Dymond, 1955) and were widely distributed in the United States before the 1880's. They are now found in most of the major river systems of this continent. The rapid spread of

this fish is partly due to man's activities and partly due to the carp's versatility and ability to penetrate into new watersheds. While carp are used as food in some areas, they are now generally considered to be a pest because they destroy vegetation and compete seriously with more desirable fish for food, and attempts have been made to eradicate them from some lake systems.

In British Columbia, carp are now found in most of the lakes of the Okanagan, in Arrow, Twin, Horne, Christina, and other lakes of the Columbia system, in the Fraser system, and in Glen Lake on Vancouver Island (Carl and Clemens, 1953). Carp have been found recently in the Squamish system and they are believed to have also extended their range by following the Fraser River "fan" at least to Porlier Pass (Barraclough, 1970).



Carp.

The carp on the mainland apparently originated from stock first introduced into Washington in 1882. Clemens *et al.* (1939) give 1917 as the probable date when carp first appeared in Okanagan Lake. Those in the Shuswap Lake region were first noted about 1928. It is locally believed that they entered this region through creek-courses or irrigation-ditches near Armstrong, where the divide separating the two great watersheds is of very low elevation. Specimens taken in Popkum Creek near Chilliwack in 1939 or 1940, in Hatzic Lake in 1944, and one individual off Point Grey

in brackish water on June 7, 1946, indicate that carp have now made their way down the Fraser system to the coast.

The carp on Vancouver Island are said to have been introduced into a swampy pond adjoining Glen Lake more than 50 years ago. Those in the lake may have been planted at the same time or may have escaped from the pond to the lake by way of drainage-ditches. They are now the dominant fish in this lake.

Carp are readily recognized by their thick-set body with large conspicuous scales. Two barbels or whiskers are attached to each side of the upper jaw near the angle. The dorsal and the anal fin are each armed with a toothed spine. The colour of the body is greenish to brownish on the back and sides and yellowish on the underparts. The lower fins may be reddish.

The carp originally came from the fresh waters of central Asia; it has been introduced widely throughout Europe and America.

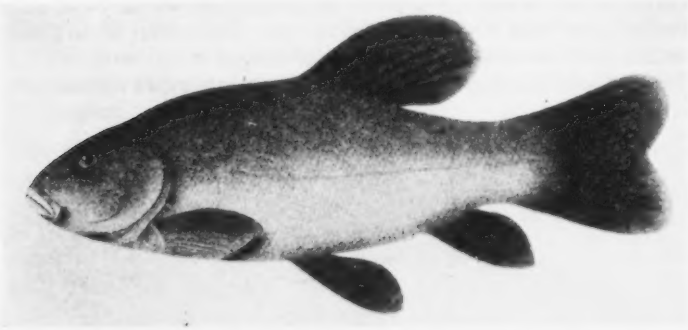
Tench

European tench (*Tinca tinca* L.) are present in Christina Lake and in Osoyoos Lake of the Columbia system in southern British Columbia. They were first noted in the former about 1915 (Dymond, 1936) and were first collected at Osoyoos in 1941. Undoubtedly tench have gained access to these lakes by way of the outlet streams from Washington to the south, where they are quite widely spread (Chapman, 1942).

There appear to be two explanations pertaining to the origin of tench in Washington. According to Dymond (loc. cit.), fish of this species were brought to Seattle for the World's Fair in 1909 and afterwards were dumped into a large goldfish pond on the campus of the university. From this source some were released in Lake Union and possibly into other water systems as well.

Chapman (1942), on the other hand, states that the first known introduction of tench into the Northwest was plantings made by the United States Bureau of Fisheries in small lakes of Spokane County, Washington, and Washington County, Oregon, in 1895. Tench are now present in the Columbia River and in certain streams and lakes of the Puget Sound drainage, especially Lake Washington and communicating lakes.

In any case it seems logical to assume that the tench now found in this Province found their way north via the Columbia River system, into which Christina and Osoyoos Lakes drain.



Tench.

Tench resemble carp somewhat, but differ in having much smaller scales (more than 100 along the lateral line) and no spines in the fins. The colour is greenish-olive or golden, darker on the back and lighter on the belly.

The tench is a native of Europe, where it inhabits ponds and streams.

GOLDFISH

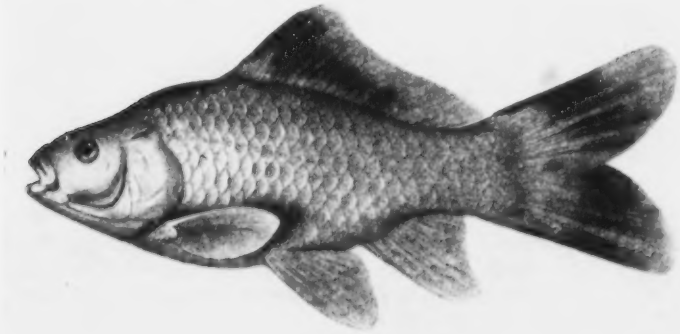
Goldfish (*Carassius auratus* (L.)) are known to be present in a large natural pond at Salmon Arm and in a small lake in the Lac du Bois area near Kamloops. Those in the pond were first noted in 1935, and a peak population was attained in 1941, when large numbers formed a dark gold band around the edge as the fish congregated in the shallows (Carl, 1945). Many brightly coloured individuals were present at that time, but as these tended to be taken by ospreys and other predators, the population gradually became composed mainly of fish possessing the ancestral olivaceous colour.

These wild goldfish undoubtedly originated from a few individuals turned loose from an ornamental pond or aquarium. In

isolated ponds and small lakes they would probably do no harm, but in systems that support sport or commercial fishes they are certainly undesirable.

Goldfish resemble carp, but lack the characteristic barbels at the corner of the mouth. The scales are larger than in the carp, numbering fewer than 30 along the lateral line. The colour is olivaceous or brownish, often orange, reddish, or variegated.

The wild fish from which goldfish have originated are native to eastern Asia.



Goldfish.

Mosquito Fish

Top minnows (presumably *Gambusia affinis* or *Lebistes reticulatus*) were introduced into a natural pond in the Kelowna area by the Kelowna Golf Club in 1929 as part of a mosquito-control programme. Regarding the history of the introduction, Game Warden W. R. Maxon, of Kelowna, reported that ". . . the minnows were quite active the first summer they were liberated and a considerable decrease in the mosquito population was noticed, but owing to the dense growth of Bulrushes around the edge of the pond the Minnows were unable to work 100 per cent. There were little pockets of water which the minnows could not get into.

During the following summer no minnows were observed. This was no doubt caused by winter kill. There is no fresh water running into the pond, and as it was used for a skating rink during the cold weather the ice became so thick the minnows died, and none have been observed since." (Report, Office of Game Commission.)

Gambusia affinis is native to the southeastern Atlantic States; *Lebistes reticulatus* comes originally from Trinidad, Venezuela, and the Guianas.

Green frog.

Green Frog

For a number of years, green frogs (*Rana clamitans* Latreille) used to be present in a few ponds on the outskirts of Victoria and possibly also in some of the small lakes of the district. Their present status is unknown, but small populations probably still exist where the growth of the city has not eliminated the habitat. They have also been collected at Little Mountain, Hope, about 90 miles up the Fraser Valley from the coast (1948 and 1949) and are now a common amphibian around the lower reaches of the Fraser River at Ladner and Westham Island (Campbell, 1972).

The natural range of the green frog is eastern North America from Hudson Bay to the Gulf of Mexico.

Green frogs are imported from time to time as tadpoles and sold as such by dealers in pet supplies or by proprietors of aquatic gardens. Without doubt the green frogs found in the wild state in the vicinity of Victoria owe their origin to stock imported for this trade, and it is likely that the Hope specimens come from a similar source.

The green frog is most likely to be confused with the bullfrog, from which it differs in its smaller size (up to 10 cm. (4 inches)) and in the presence of a fold of skin along the side of the body. The side of the head is often a bright green, and the throat of the male is bright yellow-green or orange-yellow.

Bullfrog.

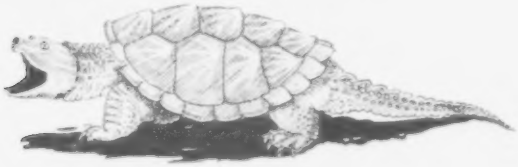
BULLFROG

The bullfrog (*Rana catesbeiana* Shaw) has always been of interest as a source of food, and consequently it is not surprising to find that this species has been imported to many parts of this continent where it does not naturally occur. Efforts to start "frog farms" in various parts of British Columbia no doubt account for the bullfrogs now found in the wild state throughout the lower mainland and in the Okanagan. Such places include Deer Lake, Burnaby Lake, Still Creek, Pitt Meadows, Sumas, Abbotsford, Mike Lake, Hatzic,

Penticton, and others. Bullfrogs were first noted in the Burnaby Lake area about 1940 and were reported from Sumas in 1948 by the late J. W. Winson, of Huntingdon, British Columbia.

The natural range of the bullfrog is throughout most of North America east of the Rocky Mountains. It has been introduced into the western United States and other areas, including Cuba, Mexico, and the Hawaiian Islands.

The bullfrog may be recognized by its large size (up to 20 cm. (8 inches) in length) and by the absence of a skin fold along the side of the body and the green mask, both of which are found in the green frog. The very large ear-drum, particularly in the male, distinguishes this from any of the native species.



Snapping turtle.

Snapping Turtle

In 1913 six snapping turtles (presumably *Chelydra serpentina* L. from eastern Canada) were released in a slough near Woodwards Landing by D. Woodward, according to the late T. L. Thacker, of Hope, British Columbia. Ten years later a snapping turtle was collected near Steveston, a few miles below Woodwards Landing, on the North Arm of the Fraser River, but apart from this record none has been seen since.

The snapping turtle may be recognized by its dull, rough shell with heavy keels and a toothed edge, especially in young individuals. The tail is large and has a crest. In weight it may reach 18 kilograms (40 pounds).

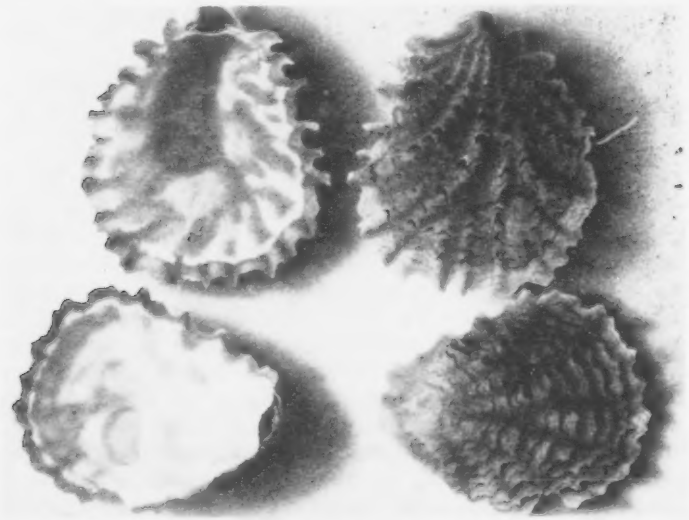
The natural range of the snapping turtle is North America east of the Rocky Mountains.

SECTION IV—INTRODUCED INVERTEBRATES

Japanese Oyster

The Japanese or "Pacific" oyster (*Crassostrea gigas* Thurnberg) was first introduced into the Puget Sound area in 1902, and the first shipment of seed oysters to be planted in British Columbia arrived in 1914. By 1926 a considerable industry had developed in Samish Bay near Bellingham, Washington, and success had been attained by plantings in Ladysmith Harbour, Vancouver Island (Elsey, 1932). By 1932 about four million seed oysters had been imported into British Columbia and planted mostly in Ladysmith Harbour. In subsequent years, seed was also planted in Boundary Bay (Crescent Beach), Pender Harbour, Baynes Sound, Cortes Island, and other areas.

Natural spawning was first observed in 1926 (Ladysmith Harbour), but it may have taken place earlier than this date, possibly



Japanese oyster.

in other areas where fishermen may have planted oysters for their own use. The first major spawnings followed by heavy spatfalls occurred in 1932 and 1936 in Ladysmith Harbour, and in subsequent years scattered individuals were found many miles from this centre. Since then breeding has been irregular. Extensive breeding in Baynes Sound and Pender Harbour in 1942 and 1958 resulted in the distribution of the Pacific oyster throughout northern Georgia Strait. Consistent breeding in Pendrell Sound and occasional breeding on the west coast in Barkley Sound and Sidney Inlet are reported by Quayle (1971).

The Japanese oyster may be distinguished from the native oyster by its much larger shell at maturity (up to 30 cm. (12 inches) in length) and from the Eastern oyster by the presence of prominent laminated ridges in the shell. The colour of the shell is usually purplish, changing to grey in old individuals. When the shell is opened, the mantle may be found to have a black border, in strong contrast to the Eastern oyster, which has a light-bordered mantle. It is said that when Japanese oysters were first placed on public sale, some distributors trimmed off the black edge to the mantle to make the shell-fish more acceptable to a suspicious public, a practice that was soon discontinued!

Japanese oyster seed is transported from Japan as deck cargo in wooden boxes holding about 1½ bushels of shell. Before the advent of careful inspection and better washing facilities, a variety of species of marine animals and plants were, and still are, being carried with the seed oysters in a live condition either attached to shell or imbedded in the mud in crevices in the shell. Kincaid (1946) lists 10 species of molluscs taken from several seed-boxes in one shipment, and hydroids, anemones, sea-worms, barnacles, and seaweeds have been observed.

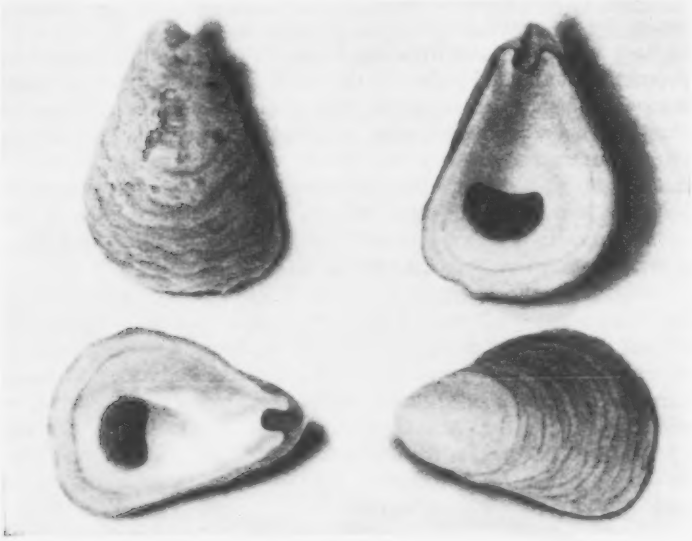
A careful search of oyster-beds may reveal that some of these species have become established.

Eastern Oyster

Atlantic Coast oysters (*Crassostrea virginica* Gmelin) were brought across the continent to the Pacific soon after the first railway line was completed early in the 20th century. The first re-

corded introduction for British Columbia consisted of three or four carloads of oysters, which were planted in Boundary Bay and Esquimalt Harbour in 1906 (Elsey, 1933).

The first importations were apparently of young seed oysters, but the mortality was so high later shipments consisted chiefly of 3- and 4-year-old oysters, but even with this material the margin of profit was so small that by 1912 the quantity imported began to diminish greatly. In recent years no Eastern oysters have been imported.

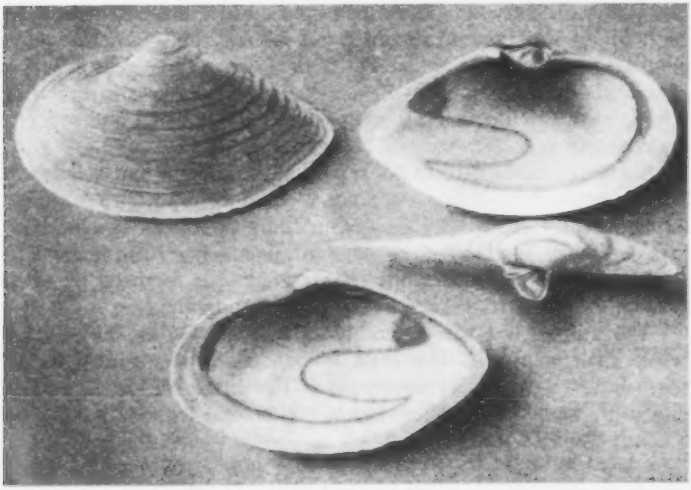


Eastern oyster.

There is no record of the year when Eastern oysters first spawned in British Columbia, but in 1917 and 1918 spat were discovered in the tidal portions of the Nicomekl and Serpentine, two muddy rivers that empty into Boundary Bay.

The Eastern oyster is easily distinguished from the native oyster by its larger size at maturity 9 to 15 cm. (3½ to 6 inches) in length, and it may be easily separated from the Japanese species because the shell is yellowish-brown (not tinted with purple) and lacks the laminations and deep grooves of the Oriental oyster. The mantle, which lies next to the inside of the shell, has a light brown border, not black as in the Japanese oyster.

The natural range of the Eastern oyster is from the Gulf of St. Lawrence to the Gulf of Mexico and the West Indies.



Soft-shell clam.

Soft-shell Clam

The soft-shell clam (*Mya arenaria* L.) is widely distributed in Europe and along the Atlantic Coast of North America, but is not native to the Pacific Coast. It first came to notice in 1874, when a few specimens were found at Oakland, California, having possibly been accidentally introduced at this point along with seed oysters from Chesapeake Bay.

The new import multiplied rapidly, with the result that it soon was being exploited commercially in the San Francisco Bay area and began to spread outside the Golden Gate.

Taylor (1895) stated it had not been found at Victoria prior to 1888, but by 1890 it occurred in abundance, and by 1895 had extended its range to northern Vancouver Island. The species probably spread from Puget Sound, where clams had been planted from Willapa Harbour, in which area they had been abundant since 1884.

Thompson (1912) recorded it from southern British Columbia, but not the Queen Charlotte Islands. In 1939 extensive beds were found in Masset Inlet in those islands, and in 1955 small numbers were found in Naden Harbour. In the same year (1955), *Mya arenaria* was taken in Prince Rupert Harbour and in Work Canal, although doubtless the species had occurred there for a considerable time but had not been reported.

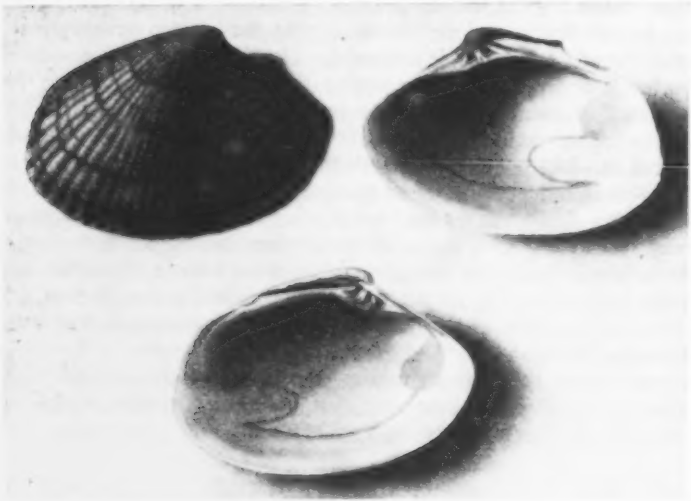
Some confusion still exists regarding the origin and speciation of *Mya arenaria* on this coast, since it has been reported (probably erroneously) from British Columbia Indian middens and because *Mya japonica* (also known as *Mya intermedia*), a form intermediate between *Mya arenaria* and *Mya truncata,* is reported by some authors to occur from Alaska south to Washington.

The soft-shell clam is readily recognized by its thin, rather brittle shell, gaping at the ends. The outside is white, with the edges covered with grey epidermis. The inside of the left valve shows a spoon-shaped hinge-tooth. The total length of the shell is about 8 cm. (3 inches).

Japanese Little-neck Clam

The Japanese little-neck or Manila clam (*Venerupis japonicus* Deshayes) was first discovered in 1936 in Ladysmith Harbour, where it had presumedly been introduced by accident along with seed oysters from Japan (Quayle, 1941). In a few years it became more abundant in this area than the native little-neck and soon entered into the commercial catch.

The larvæ presumedly spread from this centre mainly by the aid of tidal currents, so that adults began to appear many miles from



Japanese little-neck clam.

the point of original introduction. Thus, Neave (1944) records the spread as follows: Saanich Inlet (Somenos Island), 1942; Departure Bay (Nanaimo), 1942; Bargain Harbour (near Pender Harbour), 1942; False Narrows, 1944; Nanoose Bay, 1944; False Bay (Lasqueti Island), 1944. Since in all these instances some of the clams were several years old, the actual invasion must have materially preceded these dates of discovery. It now occurs throughout Georgia Strait and on the west coast of Vancouver Island north to Quatsino Sound (Quayle, 1971). The tidal passages at the northern end of Georgia Strait presumably create a temperature barrier, for it does not occur north of Seymour Narrows.

The Japanese little-neck differs from the native species (*Protothaca staminea*) in its longer shape and in the fact that the siphon or "neck" is split into two tubes at the tip. It ranges in size up to 65 mm. (2½ inches) in length. The outside of the

shell shows a great variety of colour patterns, mottled with green, brown, or black, and the inside of the shell has a yellow tinge, with the blunt end purple coloured. Usually the Japanese species buries less deeply than the native little-neck and can often be obtained in numbers by merely scooping up the gravel by hand. It also occurs at a higher tidal level than the native species and, therefore, does not compete with them very much for space.

The introduction of the Japanese little-neck clam into British Columbia demonstrates the rapidity with which a foreign species may spread and increase in numbers when in new territory. It is fortunate, indeed, that this species has proved to be of marketable value and apparently of no harm to native molluscs. It does not often happen that an accidental introduction, such as in this case, turns out to be an asset and not a liability.

In Japan this species carries a commensal pycnogonid (sea spider, *Nymphonella tapetum*), but it has not been recorded as yet from the North American Pacific Coast.

Japanese Oyster Drill

The Japanese oyster drill (*Ocenebra japonica* Dunker) was accidentally introduced into British Columbia and the State of Washington with Japanese oyster seed.

Japanese oyster drill.

It has been fairly abundant in Ladysmith Harbour since about 1935 and in Boundary Bay since about 1942. It is not an extremely serious pest in the latter area, but in Ladysmith Harbour it causes considerable damage to seed oysters. Individual specimens have been found in Comox Harbour and at Sooke. Recent records are from Crofton, Henry Bay, and Thetis Island (Quayle, 1971).

Fortunately this species does not have a pelagic larva, and distribution is accomplished almost entirely by mechanical means,

for the migratory power of the species appears to be quite limited. As far as can be ascertained, the distribution of the drill throughout Ladysmith Harbour has been unchanged for the last 15 to 20 years.

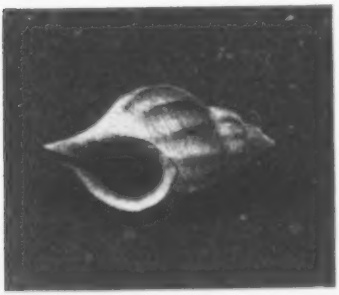
During the last few years, rigorous inspection of oyster seed before it leaves Japan has no doubt done much to decrease the frequency of infestation of new areas. However, as long as Japanese oyster seed is brought in to British Columbia, there will always be a potential danger. Regulations governing the interbed movement of oysters and equipment have been implemented to prevent distribution from the already infested grounds.

So far no economical method of control has been found.

The Japanese oyster drill (*Ocenebra*) attains a length of 40 mm. (1½ inches) or more. It resembles very closely the native wrinkled purple (*Thais lamellosa*) in having a series of prominent ribs, but these are more pronounced. Furthermore, the aperture of the shell is bordered by a broad lip with a definite inner edge and the canal is more often closed than open (D. B. Quayle).

Eastern Oyster Drill

The eastern oyster drill (*Urosalpinx cinerea* Say) apparently arrived on the west coast of Canada along with oysters from the Atlantic Coast. The date of arrival is not known, but it was probably about 1906 or shortly after. It soon became a pest of some importance on the oyster beds in Boundary Bay near Crescent Beach and subsequently made its appearance in Ladysmith Harbour, where only occasional specimens are now found.



Eastern oyster drill.

Since the importation of Atlantic oysters has stopped, the abundance of this species has apparently decreased, and in comparison to the Japanese drill (*Ocenebra*) it is not considered a serious pest.

The eastern oyster drill resembles the native dire whelk (*Searlesia dira* Reeve) in shape, but may be recognized by its ash-coloured shell with a long, pointed spire. It may slightly exceed 1 inch in length. The colour inside is reddish. The egg-cases are vase-shaped and are attached to stones or other objects at the low-tide level.

The eastern oyster drill is distributed along the Atlantic Coast from Nova Scotia to southern Florida.

Eastern Mud Nassa

The Eastern mud nassa (*Nassarius obsoletus* Say) has also been accidentally brought to the British Columbia coast along with Atlantic oysters. It is now firmly established in considerable numbers in the Boundary Bay area, inhabiting chiefly the soft muddy habitats. The species is not harmful to oysters.

Eastern mud nassa.

The shell varies from 20 to 25 mm. (¾ to 1 inch) in length and is usually covered with mud and algæ. The colour is dark brown, lighter at the tip where it is eroded. Inside, it is glazed with brown and grey. The outer lip has rounded teeth that run back into the aperture as ridges.

The natural range of the mud nassa is along the Atlantic Coast from the Gulf of St. Lawrence to northeast Florida.

Lobster

Several attempts to establish lobsters on the Pacific Coast of Canada have been made in the past, but none of these early introductions succeeded. They have been summarized in part as follows by Adams (1948):

Date	Number Shipped	Place of Plantings	Number Planted
July 2, 1896	600	Nanaimo lighthouse	196
		Near shore, surrounded by net	72
		En route to Nanaimo	32
June 8, 1905	1,025	Bay above Second Narrows on south side of Burrard Inlet	590
		Secret Cove, Sechelt Peninsula	43
		Long Bay, southeast corner of Gambier Island	43
		Snug Cove, east of Bowen Island	43
		False Narrows	135
		Nanoose Bay	171
April 9, 1908	1,620	Sooke Harbour	1,100
1917	?	Died in transit	——

In 1946 a further lot of lobsters was brought out from Prince Edward Island through British Columbia Packers Limited. They were divided into two lots. One group was confined in a large concrete tank at the Pacific Biological Station, Departure Bay, Nanaimo, but the lobsters in this lot died before the second day.

Lobster.

The second lot of 1,606 individuals was released in a lagoon on Lasqueti Island, where they were kept under observation but were not confined. A trapping programme was carried on in the lagoon each season but was discontinued after 1948, when only three lobsters were taken.

In 1954, A. B. Faulkner, of the Prince Rupert Lobster and Oyster Company Limited, imported several lots of lobsters from St. Andrews, N.B., under a special licence granted by the Federal Department of Fisheries. The crustaceans were kept in confinement, where moulting, laying, carrying of the eggs, and hatching of the young were observed.

Mr. Faulkner writes:

"Following the hatching of larvæ in the summer of 1955, we released about eighteen mature lobsters in the salt water lagoon behind the net. That winter the net was breached by drift logs and big tides, and these lobsters were free to leave. We have reports of two lobsters being taken in crab hoops in Prince Rupert harbour in the summer of 1956, and a sworn statement that one lobster in good condition was taken in May, 1956, at the north end of Stevens Island, about 20 miles distant. No other lobsters have been released.

"Our latest shipment was in 1956 and a number of these lobsters are still alive in our pens after moulting this summer (1957). The principal mortality is from lobsters fighting each other; the remainder from inimical conditions in the small cages where they are confined."

Between 1965 and 1967 the Fisheries Research Board of Canada introduced 5,000 carefully screened adult lobsters to Fatty Basin on the west coast of Vancouver Island (Ghelordi, 1967). These have been moulting and reproducing successfully in the area. Hatchery-produced larvæ have also been successful. Indications are that the introduction, though still in the experimental stage, may lead to viable self-producing populations (Shoop, 1971).

The American lobster is readily identified by the presence of the two large claws or pincers. The only other native crustaceans that resemble it are ghost shrimps or mud shrimps (*Upogebia* and *Callisanassa*), which live in burrows in muddy sand, and the crayfish, which is confined to fresh water. The California spiny lobster of the Pacific Coast resembles the American lobster at first glance but lacks the characteristic pincers.

The natural range of the lobster is the Atlantic Coast of America, north of Cape Cod.

Slugs

Several species of European slugs have become established in British Columbia, and some of them have proved to be serious pests in gardens, fields, and greenhouses. The more important ones are as follows:

Limax maximus L.—Great Slug of Europe

Length up to 6 inches. Longitudinally streaked or spotted with black on a light ground colour; bottom of foot ash coloured. Breathing pore (on the right side only) in rear half of body shield.

Great slug.

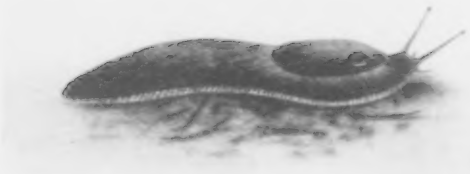
Deroceras agrestis (L.)—Brown Slug or Milky Slug

Length up to 2 inches. Colour, brown, grey, whitish, or black. Reticulations quite pronounced. Slime sticky and opaque white in colour.

Brown slug.

Arion ater (L.)—Black Slug

Length up to 5 inches. Blue-black in colour but may be brown, reddish, yellowish, or greenish. Edge of foot with yellowish border crossed by closely set black lines; breathing pore in front half of shield. First found in 1945 at New Westminster (King).



Black slug.

The grey garden slug (*Arion circumscriptus*) has also been recorded from British Columbia, and two other species, *Arion hortensis* Fer. and *Milas gagates* (Drap.) may also be present, since they are already established in the State of Washington near Seattle.

How and when any of these slugs arrived in British Columbia appears to be unknown. They could have arrived either as eggs or as adults directly along with plant importations from England or from other European countries, or some of the species may have come indirectly from other parts of Canada or from the United States where they are already established and widespread.

Isopods or Sowbugs

A number of isopods (commonly called sowbugs, wood lice, or slaters) appear to be introduced species, most probably from Europe. Because of their general habit of living in farmyards and other areas close to man, they have apparently been rather easily transported, so that many are now almost world-wide in distribution.

Most of the following material is taken from Spencer (1942) and Hatch (1947).

Sowbug

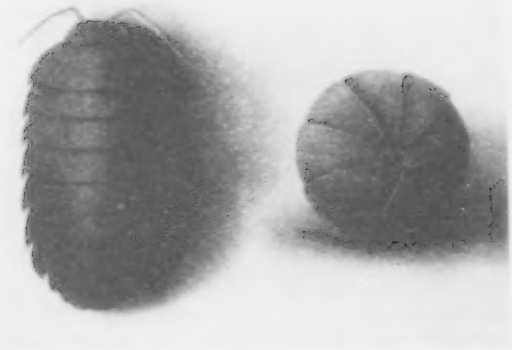
Porcellio scaber Latreille — Common Sowbug or Woodlouse

Common on the coast region of British Columbia, but not found at Prince Rupert prior to 1926 (Walker, 1927). Found in damp places, under boards, and other shelter near decaying vegetation.

Colour, dark grey, sometimes with spots; dorsal surface rough. Incapable of rolling into a ball.

Apparently introduced from Europe; widely spread in North America.

Armadillidium vulgare (Latreille)—Pillbug



Pillbug

Sometimes found in greenhouses, where it may become a pest. Reported from Burnaby, Langley Prairie, North Vancouver, Vancouver, and Victoria.

Colour, shiny blue-grey; surface smooth. Capable of rolling into a ball.

Introduced, probably from Europe; widely spread in the United States.

Armadillidium nasatum B.-L.

Tunnels readily into flower-pots and destroys root systems. Recorded from Langley Prairie (since 1941).

Oniscus asellus L.

Extremely abundant in greenhouses in southwestern British Columbia. Recorded from Burnaby, Langley Prairie, North Vancouver, Kootenay State Park (near Fernie), Stanley Park, and Vancouver (as *O. affinis*).

Porcellio dilatatus Br.

Reported from Burnaby near Vancouver.

Porcellionides pruinosus Br.

An agile species taken at Lytton.

Trachelipus rathkei Br.

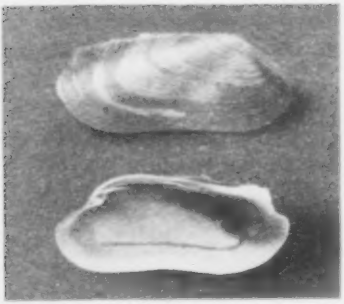
Recorded from Salmon Arm, Shuswap Lake, and Vancouver.

Cylisticus convexus DeG.

Reported from Kamloops.

Miscellaneous Species

There appear to be a number of organisms in British Columbia that are of questionable status. In a vain attempt to be complete, we list the following species.



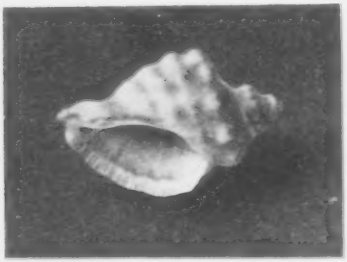
Japanese clam (*Trapezium*).

Japanese Clam

This rather small nestling clam (*Trapezium liratum* Reeve) is also transported from Japan on oyster seed, and is often found among oysters from this source after two years or so, when the clusters are being broken. It has attained a length of 1½ inches in Ladysmith Harbour. There is no evidence that it has been able to breed successfully in British Columbia waters, but breeding has apparently occurred in Willapa Harbour in the State of Washington. It resembles *Hiatella* somewhat; the spines along the dorsal edge of the shells are very prominent.

Japanese Oyster Drill

The only record of the Japanese oyster drill (*Purpura clavigera* Kuster also known as *Thais tumulosa*) is from Ladysmith Harbour. In 1951, during a drill investigation, a group of 63 specimens of this species was collected in a very small area. As a result, the ground was searched very carefully, and it is believed and hoped that the whole population was destroyed. None has been found since. Egg-cases were taken at the time, so there appeared to be a breeding potential.



Japanese oyster drill. (*Purpura*).

This species could be more dangerous than *Ocenebra*, for it has a pelagic larva, and it is possible that rapid spread could occur.

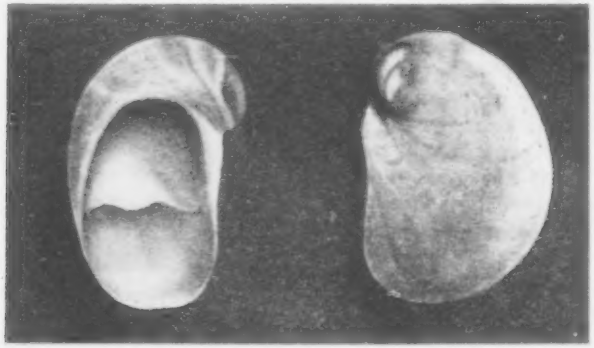
The Japanese drill may be identified by the presence of a series of knobs following the whorl of the shell. The general colour is cream with dark-brown operculum, and the size may reach 1½ inches.

Atlantic Slipper Limpet

It was thought for a long time that British Columbia was free of the oyster-bed pest known as the slipper limpet or half-decker (*Crepidula fornicata* (L.)). However, in 1953, a single specimen was found in Boundary Bay, so that in spite of the fact that it does occur, the abundance is not great. The slipper limpet is not an oyster predator like the drill, but it does compete for food and space and uses the oyster for attachment. As it has a free swimming larva, it is capable of rapid distribution under favourable conditions. It is native to the Atlantic Coast of North America but has spread to many oyster-growing areas throughout the world, particularly Great Britain, Holland, and Puget Sound.

The Atlantic slipper limpet has an oval shell up to 2 inches in length; the apex is at the margin and turned to one side. It can be distinguished from other species by the strongly concave deck with its edge waved in two places.

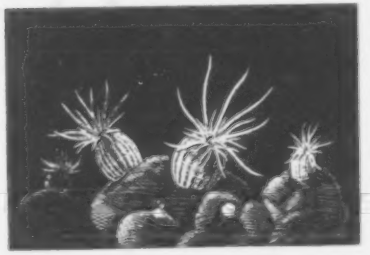
The slipper limpet ranges along the Atlantic Coast from the Maritimes to Florida and to Texas. (D. B. Quayle.)



Atlantic slipper limpet.

Asiatic Anemone

This small anemone *Haliplanella luciæ* Verrill now has a world-wide distribution, but presumably it originated from the Pacific Coast of Asia. It was present on the east coast of Vancouver Island in 1909, although it had been found earlier in San Francisco Bay. It was recorded from the British Isles in 1896 but did not reach continental Europe until 1913.



Asiatic anemone.

The Asiatic anemone presumably is transported on ships' bottoms and is also able to float base upward in the water. More recently its occurrence appears to be correlated with the planting of Japanese seed oysters, and certainly it is not difficult to find anemones answering to the description of *Diadumene* on oyster-shells as they are taken from the seed-cases on arrival in British Columbia.

The species may be distinguished by the vertical orange stripes on a green background. It appears to flourish for a time after it has been introduced to an area, and then it dies out or becomes small in size and in numbers.

Oyster-eating Flatworm

Excessive mortality among oyster spat in Puget Sound was found to be due to predation by a flatworm (*Pseudostylochus ostreophagus Hyman*). The same species was also found to occur in Japan, where it had been responsible for considerable mortality in young spat, although this had not been realized. It has now been concluded that this is a Japanese species.

The populations of the worm in Puget Sound seem to fluctuate rapidly, possibly because it appears to be unable to withstand low water salinities, and the life-span is apparently not more than one year.

The oyster-eating flatworm is broadly ovate, about half as wide as long, with a broadly rounded anterior end and a slightly narrowed posterior half. It may also be oval, with both ends rounded. It reaches a length of 1½ inches. The general colour is greenish or greyish, speckled uniformly with dark brown. (For descriptive details *see* L. H. Hymand in Amer. Mus. Novitates, No. 1704, Jan. 1955.)

The flatworm attacks the oyster by perforating the shell with a keyhole-shaped aperture, presumably by means of an oral secretion.

Since no oyster-spat mortalities of significant proportions that may have been caused by this species have been reported in British Columbia, it does not seem to have become a pest here. Although it has not been definitely identified from British Columbia, it is quite certain it occurs at least for a time after oyster seed from Japan has been planted out, for very few cases of Japanese seed are without several of the worms. Since most British Columbia oyster-beds are located in or close to estuaries, it may be that the low salinities prevailing for short periods during heavy river run-off are sufficient to keep the flatworms under control.

Oriental Parasitic Copepod

The Oriental parasitic copepod (*Mytilicola orientalis* (Mori)) has been introduced into northeast Pacific water through the medium of Japanese oyster seed. At one time this species posed a serious problem in connection with oysters in the State of Washington, as heavy infestations seriously reduced the condition of the molluscs.

Apparently the parasite occurs in British Columbia, for it has been taken from the edible mussels *Mytilus edulis* and *Mytilus californianus* and from the cockle (*Clinocardium nuttalli*).

No effort has been made to determine its exact distribution, which is widespread in areas where Japanese oyster seed has been planted.

Gribble

The tripunctate gribble *Limnoria tripunctata* is a marine crustacean that does extensive damage to all types of wooden struc-

tures. This pest is thought to have been introduced to our coastal waters by means of wooden boxes in which oyster seed is shipped from Japan. It was first recorded in British Columbia in 1961 (Quayle, 1971).

Atlantic Shipworm

It was long thought the northern distribution of the Atlantic shipworm on the Pacific coast was San Francisco Bay. In 1957 it was found in Willapa Harbour in Washington and in Pendrell Sound, British Columbia, in 1963. It has not been found elsewhere in this Province, but there is little doubt that in time it may spread. The rather special temperature (high in summer) and salinity (low in summer) in Pendrell Sound apparently favours the reproduction of both *Teredo navalis* and *Limnoria tripunctata*. *T. navalis* is a smaller species than the native *Bankia setacea*, but the attack is much more severe numerically. The two species are distinguished by the form of the pallets which are the two calcareous structures at the posterior (tail) end of the animals. In *Bankia* the pallets are feather-like with a number of sections while those of *Tereda* are single and spade-like (Quayle, 1971).

Earthworms

As in the case of the house mouse and the Norway rat, earthworms have followed the white man all over the world. All our common species are European in origin; probably they were introduced to North America by the early white settlers. The most common species, *Lumbricus terrestris*, is now found throughout the temperate parts of the continent, but only where man has cultivated the land or introduced worms as fish bait.

Dr. James A. Macnab, of Portland State College, has kindly provided us with the following list of European earthworms known to occur in British Columbia; *Lumbricus terrestris* Linnæus, *Lumbricus rubellus* Hoffmeister, *Allolobophora turgida* Eisen (formerly *A. caliginosa F. trapezoides*), *Eisenia fætida* (Savigny) (the manure worm), and *Dendroboena rubida* (Savigny) (formerly *Bimatus tenuis* (Eisen)).

Millipede

The millipede *Diplionlus hortensis* (Wood), apparently intr
duced from Europe, appears to be increasing in abundance
southern Vancouver Island (King, 1953). It is found chiefly
heavy-textured soils that are wet in winter. It often causes damag
to garden seed in the spring and to potato and dahlia tubers in th
autumn.

SECTION V—TRANSFERS WITHIN THE PROVINCE

There have been numerous transfers of both introduced an
indigenous species of mammals, birds, and other animals to Provi
cial localities originally unoccupied by those species. Many of thes
movements have not been properly recorded or the records ar
scattered and difficult to locate. As a consequence, the followin
account is incomplete. We would welcome additional information

Chipmunk (*Eutamias* sp.)

Mainland animals kept in captivity at Beacon Hill Park in Vi
toria have escaped at various times. Recent occasional reports
chipmunks from the Malahat region on Vancouver Island indicat
that some may have survived, although reports are few and un
authenticated. Individuals were seen as early as 1908 at Mill Ba
according to Mrs. John Freeman, of South Pender Island.

There have been no valid reports of chipmunks on Vancouve
Island since 1958. In 1965 Jack Todd of Victoria released 3
chipmunks on Sidney Island, from stock which originated in Or
gon. The species is now well established on that island (J. Tod
1970).

Red Squirrel (*Sciurus hudsonicus lanuginosus* (Bachman))

Six individuals were transferred from Vancouver Island to th
Queen Charlottes in 1950 by the Game Commission. In 1964 nin
red squirrels from Vancouver Island stock were introduced t
Sidney Island, where the species has become well established (
Todd, 1970).

Beaver (*Castor canadensis* Kuhl)

Beaver were first trapped for transfer at Bowron Lake in 1922 and almost annually since that time; they have been released in many areas where beavers have not occurred for many years. In 1936 beavers were transferred from the mainland to the Queen Charlotte Islands, but did not become established. Another transplant was made in 1950 with stock from Vancouver Island. They were liberated in Gold Creek and Tlell River and have established themselves there.

White-footed Mice (*Peromyscus maniculatus angustus* Hall)

Numbers of mice were transferred from Vancouver Island to the Chatham Islands, Discovery Island, and Trial Island in 1951 as part of a study of small-mammal populations (*see* Ann. Rept. Prov. Mus. for 1951 and subsequent years). Populations on some of those islands have become well established.

Muskrat (*Ondatra zibethica osoyoosensis* (Lord))

Muskrats were transferred from the mainland to Cowichan Lake, Vancouver Island, for the first time in 1922. In 1924/25 the Game Commission transferred more animals from the lower mainland to the following areas on Vancouver Island: Shaw Creek, Ucluelet, Jordan River, Port Alice, Hopkins Lake (Merville), and Comox. Muskrats are now well established on Vancouver Island and on Pender Island, where they were introduced in the 1920's by A. F. Richardson. In 1924 or 1925 muskrats were transferred from the mainland to the Queen Charlotte Islands, where large populations became established throughout the group; these have since exhibited population explosion and decline characteristic of the species.

Red Fox (*Vulpes fulva* (Desmarest))

Fox escapes from fur-farms on Vancouver Island have resulted in a population of these animals becoming established in the Sayward forest north of Campbell River. Appreciable numbers of the animals were first noticed about 1948. A sparse population has since expanded southwards to Courtenay and west almost to the head of the Alberni Canal (G. Ferguson, 1970).

Raccoon (*Procyon lotor* (L.))

Stock transferred by local trappers from Vancouver Island to Cox Island (Scott Island group) in the late 1930's has established a large population which was still extant in 1969 (B. Thomas, 1970). Introductions to the Queen Charlotte Islands about 1940 have also been successful in establishing populations throughout the islands.

Red fox.

Mink (*Mustela vison* Schreber)

Mink were transferred by local trappers from Vancouver Island to Lanz Island (Scott Island group) in the late 1930's. A large population was still present there in 1969 (B. Thomas, 1970).

Otter (*Enhydra lutris*)

Twenty-nine sea otter (*Enhydra lutris*) from Amchitka Island the Aleutian chain were released in the Bunsby Island off the st coast of Vancouver Island on July 21, 1969, by the Fish and ldlife branch. An additional 14 were released in the same area July 27, 1970. Success of these introductions is unknown at e of publication, although a few authentic sightings have been orded (McKay, 1971).

(*Cervus canadensis nelsoni* Bailey)

In 1932, 25 elk, probably from Jasper, Alberta, were trans-red to the head of Adams Lake. Five elk from Stanley Park Zoo re released at McNab Creek on Howe Sound in 1933. Thirty-elk were transferred from near Penticton to the Princeton area 1931 and 1932. Eight were placed on Graham Island in the een Charlottes. All of these transfers were successful in estab-ning populations which were still extant in 1970. An early intro-ction (no data) to the Yalakom River probably explains the ppearance of elk there and in the Bridge River and Chilcotin ions. In February 1971, 30 elk were transferred by the Fish d Wildlife Branch from Banff National Park to the Grand Forks gion where they appear to be doing well (Mundy, 1971).

llow Deer (*Dama dama* L.)

Specimens were transferred on three occasions from James and to "other gulf islands" and the Alberni district prior to and the years 1934 and 1935. Fallow deer are now present only on nes, Sidney, and Saltspring Islands.

acktail Deer (*Odocoileus hemionus* (Rafinesque))

Deer are said to have been transferred from the mainland coast from coastal islands to the Queen Charlotte Islands prior to 1901 y a Hudson's Bay Company factor; no details available). In 12 an additional 13 animals were liberated there by the British lumbia Game Commission. In 1925 three mature bucks were vaged from some reefs near Price Island and released at Sand-it, QCI, by Commodore Knight, of the Royal Canadian Navy.

Deer are now plentiful throughout those islands. Blacktail deer have been introduced from surplus zoo stock on Vancouver Island to various undisclosed Gulf Islands from time to time. Most have had little success in establishing appreciable populations.

Mountain Goat (*Oreamnos americanus* (Blainville))

In 1924 four mountain goat obtained from the National Parks Branch by the Game Commission were transferred from Banff, Alta., to Shaw Creek (Cowichan Lake) on Vancouver Island. No recent records of the animals are on file; it is said they were last seen in 1936.

California Bighorn Sheep (*Ovis canadensis californiana* Douglas)

In 1955, 18 were trapped at the junction of the Chilcotin and Fraser Rivers. Five were transferred to Vaseux Lake, two to Taseko Lake, and 11 to Westbranch in the Anahim district. In 1966, 11 animals from the Chilcotin-Fraser River band were captured by the Fish and Wildlife Branch and transferred to ranges north of Kamloops Lake. There are presently around 20 head just across the lake from Savona (R. Ritcey, 1970).

Rocky Mountain Sheep (*Ovis canadensis canadensis* Shaw)

Forty ewes and 10 rams were introduced from Banff to Squilax in 1927, although the species is said to have been present there prior to the introductions. In 1927, 35 ewes and 14 rams were transferred to Spences Bridge from the Banff National Park.

Canada Goose (*Branta canadensis canadensis* (L.))

About a dozen birds transferred from Okanagan Valley to Elk Lake near Victoria on Vancouver Island in 1931 have established a population there. A population of about 200 birds present around Elk Lake in 1957—58 appear to have dispersed in smaller flocks over the Saanich Peninsula. In recent years other transfers and introductions of Interior Canada geese have been made by private individuals to the lower mainland and on Vancouver Island (Halliday, 1971).

Blue Grouse (*Dendragapus obscurus* (Say))

In recent years blue grouse have been transferred from Vancouver Island to several undisclosed Gulf Islands under supervision of the Fish and Wildlife Branch. Transfers are part of a study being undertaken by Universities of Victoria, British Columbia, and Alberta (Mundy, 1971).

Willow Grouse (*Bonasa umbellus* (Linnæus)

Willow grouse have also been transferred recently from Vancouver Island to undisclosed Gulf Islands under supervision of the Fish and Wildlife Branch (Mundy, 1971).

Quail (*Lophortyx californica* (Shaw and Nodder))

Stock was transferred to Vanderhoof area about 1955, probably from the lower mainland.

Pheasants (*Phasianus colchicus* Gmelin)

Ring-necked pheasants have been transferred to the Queen Charlotte Islands and to Vanderhoof, Nicola, Telkwa, and McBride. In addition, until 1954, pheasants raised commercially on the mainland for the purpose of subsidizing hunting were transferred to some Gulf Islands, Vancouver Island, and other points within the Province, by the Fish and Wildlife Branch.

In recent years, the introduction of pheasants to private property for subsidized hunting has been carried out, under permit, by only a few private individuals on the lower mainland and in the Gulf Islands. The early northern and insular introductions have failed except on Vancouver Island where small numbers survive, mainly on the Saanich Peninsula.

Western Painted Turtle (*Chrysemys belli belli* (Gray))

Thirty-two painted turtles collected in the Okanagan Valley were released in a pond near Kawkawa Lake, Hope, British Columbia, in 1922 by T. L. Thacker, of Little Mountain, Hope. For several successive years individual turtles were seen in the lake, but none has been observed recently.

Game Fishes

Over the years innumerable transfers of game fishes have been made within the Province. These include the transfer of eggs, fry, and fingerlings of both trout and salmon from one river system to another, sometimes as deliberate attempts to restock or to initiate runs of fish and sometimes as part of a research programme. Such records of transfers as exist may be found in the Annual Reports of the Federal Fisheries Department, in the files of the Provincial Game Office (Vancouver) and the Pacific Biological Station (Nanaimo).

Recent transfers of smallmouth bass have already been noted under that species.

Recent transfers within the Province are as follows: Lake Trout (*Salvelinus namaycush*) to Allouette Lake in 1968/69; Splake trout (*S. namaycush* x *S. fontinalis*) to Stump Lake in 1968; Dolly Varden (*Salvelinus alpinus*) to Dickinson Lake in 1969; Coho salmon (*Oncorhynchus kisutch*) to Flathead Lake in 1969.

Nongame Fishes

Numerous unauthorized and unrecorded transfers of nongame fishes have undoubtedly occurred. One such example is given by Larkin and Smith (1954).

Crayfish (*Astacus trowbridgei* Stimpson)

A number of crayfish were transferred from Shawnigan Lake (Vancouver Island) to Paul Lake (Kamloops) in 1935 (*see* Ann. Rept. Biol. Bd. Can. for 1935 (1936), pp. 25–36) for the purpose of providing a new food item for larger Kamloops trout. A few individuals were seen in Paul Lake a year or two later, but none has been seen since, although the lake has been under close study in recent years.

(The crayfish in Shawnigan Lake were said to be the descendants of specimens imported from Oregon many years ago by the late Judge Hunter, but in view of their presence in several other river systems on Vancouver Island, it seems more likely that these crustaceans are indigenous.)

REFERENCES

(NOTE—An extensive bibliography of introduced or transplanted animals is maintained by Dr. Herbert W. Levi, Museum of Comparative Zoology, Harvard University, Cambridge 38, Mass.)

ADAMS, J. R.
1948. An Interim Report on an Experiment to Introduce Atlantic Lobsters Into Canadian Pacific Coast Waters. Mimeo Rept. Pac. Biol. Stn., Nanaimo, British Columbia, pp. 1–24.

ANDRUSAK, H.
1971. Personal Communication. Fish and Wildlife Branch, Cranbrook, British Columbia.

BARRACLOUGH, W. E., and ROBINSON, D. G.
1971. Juvenile Carp *Cyprinus carpio* in the Strait of Georgia, British Columbia. Unpublished MSs. Fisheries Research Board of Canada.

BARROWS, WALTER B.
1889. The English Sparrow (*Passer domesticus*) in North America. Bull. 1, U.S. Dept. Agriculture, Div. Economic Ornithology and Mammalogy.

BEST, ALAN
1970. Personal Communication. Stanley Park Zoo, Vancouver, British Columbia.

Biol. Bd. of Canada, 1936 Ann. Rept. for 1935 [Crayfish transfer], pp. 25–26.

BROOKS, ALLAN, and SWARTH, HARRY S.
1925. A Distributional List of the Birds of British Columbia. Cooper Ornith. Club, No. 17.

BUCKELL, E. R.
1929. The Dermaptera (Earwigs) of Canada. Proc. Ent. Soc. B.C., No. 26, pp. 9–27.

CAMPBELL, W.
1971. Personal Communication. Univ. of British Columbia, Vancouver, British Columbia.

CARL, G. CLIFFORD

1938. A Spawning Run of Brown Trout in the Cowichan River System. Fish. Res. Bd. Can. Prog. Rept. Pac., No. 36, pp. 12–13.

1945. Three Apparently Unrecorded Fresh-water Fishes in British Columbia [Black Catfish, Pike-perch, and Goldfish]. Canad. Field-Nat., Vol. 59, No. 1, p. 25.

1950. The Amphibians of British Columbia [Green Frog and Bullfrog]. British Columbia Prov. Mus. Handbook No. 2, pp. 1–62.

1952. Alien Animals on Vancouver Island. Victoria Naturalist, Vol. 9, No. 1, pp. 7–10.

CARL, G. C., and CLEMENS, W. A.

1953. The Fresh-water Fishes of British Columbia. British Columbia Prov. Mus. Handbook No. 5, pp. 1–136.

CARL, G. CLIFFORD; GUIGUET, C. J.; and HARDY, G. A.

1951. Biology of the Scott Island Group, British Columbia [Transfer of Mink, Raccoon, and European Rabbit]. Rept. of the Prov. Mus. for 1950, pp. 21–63.

CHAPMAN, W. M.

1942. Alien Fishes in the Waters of the Pacific Northwest [Carp, Tench, Catfish]. Calif. Fish and Game, Vol. 28, No. 1, pp. 9–15.

CLEMENS, W. A.; RAWSON, D. S.; and MCHUGH, J.

1939. A Biological Survey of Okanagan Lake, British Columbia [Carp]. Fish Res. Bd. Can., Bull. 56, pp. 1–70.

COUCH, L. K.

1929. Introduced European Rabbits in the San Juan Islands, Washington. Journ. Mammalogy, Vol. 10, pp. 334–336.

COWAN, I. MCT., and GUIGUET, C. J.

1956. The Mammals of British Columbia. British Columbia Prov. Mus. Handbook No. 11, pp. 1–413.

DEMARCHI, RAY

1967. Personal Communication. Fish and Wildlife Branch, Cranbrook, British Columbia.

DE VOS, ANTOON; MANVILLE, RICHARD H.; and VAN GELDER, RICHARD G.
1956. Introduced Mammals and Their Influence on Native Biota. Zoologica, Vol. 41, Part 4, pp. 163–194.

DYMOND, J. R.
1936. Some Fresh-water Fishes of British Columbia [Atlantic Salmon]. Rept. Comm. of Fish., British Columbia, 1935, pp. 60–73.
1955. Introduction of Foreign Fishes in Canada. Proc. Internat. Assoc. Theoretical and Applied Limnology, Vol. 12, pp. 543–553.

ELSEY, C. R.
1933. Oysters in British Columbia. Biol. Bd. Can. (Fisheries Res. Bd.), Bull. 34, 1933.

ELSEY, C. R., and QUAYLE, D. B.
1939. Distribution of Oyster Larvæ From the 1936 Spawning in Ladysmith Harbour [Japanese Oyster]. Fish. Res. Bd. Canada, Prog. Rept. (Pacific), No. 40, pp. 8–10.

FERGUSON, GEORGE
1970. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

FORRESTER, C. R.; PEDEN, ALEX E.; and WILSON, R. M.
1971. First Records of the Striped Bass, *Morone saxatilis* (Walbaum) in British Columbia Waters. Fish. Res. Bd. Can., publication in press.

GATES, BRIAN
1970. Personal Communication. Fish and Wildlife Branch, Vancouver, British Columbia.

GHELARDI, R. J.
1967. Progress Report on the 1965 and 1966 Lobster Introductions at Fatty Basin, Vancouver Island, British Columbia. Fish. Res. Bd. Canada. Tech. Rept. No. 44.

GUIGUET, C. J.
1952. The European Starling on Vancouver Island. Canad. Field-Nat., Vol. 66, No. 1, p. 37.

GUIGUET, C. J.
1952. European Starling. Victoria Naturalist, Vol. 9, No. 2, p. 22.
1952. Another Record of Crested Mynah on Vancouver Island. Victoria Naturalist, Vol. 9, No. 5, pp. 52–53.
1955. The Birds of British Columbia: (4) Upland Game Birds. British Columbia Prov. Mus. Handbook No. 10, pp. 1–47.

HAINES, FRANCIS
1938. Where Did the Plains Indians Get Their Horses? American Anthropology, Vol. 40, pp. 112–117.
1938. Horses Among the Plains Indians. American Anthropology, Vol. 40, pp. 429–437.

HALLADAY, D. R.
1971. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

HART, J. L.
1934. Black Crappies in British Columbia. Canad. Field-Nat., Vol. 48, No. 6, pp. 103–104.

HATCH, MELVILLE H.
1947. The Chelifera and Isopoda of Washington and Adjacent Regions [Sowbugs]. Univ. Wash. Pub. Biology, Vol. 10, No. 5, pp. 155–274.

HENDERSON, JUNIUS
1929. Nonmarine Mollusca of Oregon and Washington [Slugs]. Univ. Colorado Studies, Vol. 17, No. 2, pp. 1–190.

KEENLEYSIDE, MILES H. A.
1954. First Record of the Brassy Minnow, *Hybognathus hankinsonii* Hubbs, From British Columbia. Canad. Field-Nat., Vol. 68, No. 1, p. 43.

KINCAID, TREVOR
1949. Note on Molluscs Introduced With Japanese Oyster Seed. Minutes 33, Conchological Club of South. Calif., Feb., 1949, p. 1.

KING, K. M. *et al.*
1953. Regional Pest Faunas: The More Important Insect Pests of British Columbia [includes also ref. to Slugs and Millipede]. Proc. Seventh Pac. Sc. Congress, Vol. 4, pp. 121–148.

KROEBER, A. L.
1941. Culture Element Distribution XV, Salt, Dogs, Tobacco. Anthropological Records, Vol. 6, No. 1, Univ. Calif. Press.

LAMPMAN, BEN HUR
1949. The Coming of the Pond Fishes. Binfords and Mort, Portland, Ore.

LARKIN, P. A., and SMITH, S. B.
1954. Some Effects of Introduction of the Redside Shiner on Kamloops Trout in Paul Lake, British Columbia. Trans. Amer. Fish. Soc., Vol. 83 (1953), pp. 161–175.

LARRISON, E. J.
1943. Feral Coypus in Pacific Northwest [Nutria]. Murrelet, Vol. 24, pp. 3–9.

LEIRN, A. H., and SCOTT, W. B.
1966. Fishes of the Atlantic Coast of Canada. Fish. Res. Bd. Can., Bull. 155, pp. 1–485.

LEVI, HERBERT W.
1952. Evaluations of Wildlife Importations. The Scientific Monthly, Vol. 74, No. 6, pp. 315–322.

LINDEMANN, W.
1956. Transplantation of Game in Europe and Asia. Journ. Wildlife Management, Vol. 20, No. 1, pp. 68–70.

LINDSEY, C. C.
1956. Distribution and Taxonomy of Fishes in the Mackenzie Drainage of British Columbia [Possibility of Brassy Minnow Introduction]. Journ. Fish. Res. Bd. Canada, Vol. 13, No. 6, pp. 759–798.

LYDEKKER, RICHARD
1894–96. The Royal Natural History. Vol. 1 to 4.

McCrimmon, H.
1968. Carp in Canada. Fish. Res. Bd. Canada, Bull. 165: pp. 23–24.

McKay, W.
1971. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

McLeod, J. H.
1951. Biological Control Investigations in British Columbia. Ent. Soc. of B.C. Proc., Vol. 47, pp. 1–10.
1954. Statuses of Some Introduced Parasites and Their Hosts in British Columbia. Ent. Soc. of B.C. Proc. (1953), Vol. 50, pp. 19–27.

Merilees, W. J.
1971. Observations of Wild Turkey in British Columbia. Saskatchewan Nat. Hist. Soc. Journ., Vol. 24, No. 1.

Mundy, K. R. D.
1971. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

Munro, J. A.
1922. The "Japanese Starling" in Vancouver, British Columbia. Canad. Field-Nat., Vol. 36, pp. 32–33.

Munro, J. A., and Cowan, I. McT.
1947. A Review of the Bird Fauna of British Columbia. Special Publ. No. 2, British Columbia Prov. Mus., pp. 1–285.

Myres, Timothy
1955/56. 2nd Annual Report, British Columbia Nest Records Scheme. Mimeograph copy, UBC Dept. of Zoology.

Neave, Ferris
1944. The Spread of the Japanese Little-neck Clam in British Columbia Waters. Fish. Res. Bd. Canada, Prog. Rept. (Pacific), No. 61, p. 3.
1954. Introduction of Anodromous Fishes on the Pacific Coast. Can. Fish Culturist, No. 16.

NEAVE, FERRIS, and CARL, G. C.
1940. The Brown Trout on Vancouver Island. Proc. Sixth Pac. Sc. Cong., Vol. 3, pp. 341–343.

NORTHCOTE, T.
1971. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

PATCH, CLYDE A.
1922. A Biological Reconnaissance on Graham Island of the Queen Charlotte Group [Red Deer and Feral Cattle]. Canad. Field-Nat., Vol. 36, No. 6, pp. 100–105.

PRITCHARD, A. L.
1934. Was the Introduction of the Muskrat to Graham Island, Queen Charlotte Islands, Unwise? Canad. Field-Nat., Vol. 48, No. 6, p. 103.

QUAYLE, D. B.
1941. The Japanese "Little-neck" Clam Accidentally Introduced Into British Columbia Waters. Fish. Res. Bd. Can. Prog. Rept. (Pacific), No. 48, 1941, pp. 17–18.
1964. Distribution of Introduced Marine Molluscs in British Columbia Waters. J. Fish. Res. Bd. Canada 21:1155–1181.
1964. Dispersal of Introduced Marine Wood Borers in British Columbia Waters. Comptes Rendus du Congres International de la Corrosion Marine et des Salissures, pp. 409–412. Cannes, France.
1969. Pacific Oyster Culture in British Columbia. Fish. Res. Bd. Canada Bulletin 169:1–192.

RACEY, KENNETH
1953. Cottontail Rabbit in British Columbia. Murrelet, Vol. 34, No. 1, pp. 9–10.

RITCEY, R. W.
1970. Personal Communication. Fish and Wildlife Branch, Kamloops, British Columbia.

ROBINSON, D. J., and COWAN, I. McT.

1954. An Introduced Population of the Gray Squirrel (*Sciurus carolinensis* Gmelin) in British Columbia. Canad. Journ. Zool., Vol. 32, pp. 261–282.

SAUNDERS, R. M.

1935. The First Introduction of European Plants and Animals Into Canada. Canad. Hist. Review, December, pp. 388–406.

SHOOP, C.

1971. Personal Communication. Fish. Res. Bd. Canada.

SMITH, HUGH M.

1896. A Review of the History and Results of the Attempts to Acclimatize Fish and Other Water Animals in the Pacific States. U.S. Fish. Comm. Bull., Vol. 15, 1895, pp. 379–475.

SMITH, IAN

1971. Personal Communication. Fish and Wildlife Branch, Nanaimo, British Columbia.

SPALDING, D. J.

1970. Personal Communication. Fish and Wildlife Branch, Penticton, British Columbia.

SPENCER, G. J.

1942. Insects and Other Arthropods in Buildings in British Columbia (Sowbugs). Proc. Ent. Soc. B.C., 39:23–29.

STEVENSON, GEORGE

1957. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

STORER, TRACY I.

1934. Economic Effects of Introducing Alien Animals Into California. Proc. 5th Pac. Sci. Cong., 1933, Vol 1, pp. 779–784.

1937. The Muskrat as Native and Alien. Journ. Mammalogy, Vol. 18, No. 4.

TAVERNER, P. A.
1934. Birds of Canada. Bull. 72, Biological Series, No. 19, Nat. Mus. Can.

THOMAS, B.
1970. Personal Communication. Dept. Zool., Univ. of B.C., Vancouver, British Columbia.

THOMAS, R. C.
1971. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

TODD, J.
1970. Personal Communication. Sidney Island, British Columbia.

VANDEMEER, D.
1971. Personal Communication. Private Game Farm, Victoria, British Columbia.

VERNON, E. H.
1971. Personal Communication. Fish and Wildlife Branch, Victoria, British Columbia.

WALKER, E. M.
1927. The Woodlice or Oniscoidea of Canada. Canad. Field-Nat., Vol. 61, No. 8, pp. 173–179.

WYLDE, M. A.
1923. Ornithological Notes: The Migrant [Quail]. Vol. 2, No. 2, pp. 44.

Printed by K. M. MACDONALD, Printer to the Queen's Most Excellent Majesty in right of the Province of British Columbia.
1972

5M-472-3011

BRITISH COLUMBIA PROVINCIAL MUSEUM
VICTORIA, BRITISH COLUMBIA

PUBLICATIONS IN NATURAL HISTORY

CURRENT SERIES

HANDBOOK SERIES (Prices effective May 15, 1971)

No. 2 The Amphibians of British Columbia. G. Clifford Carl. 50 cents.
No. 3 The Reptiles of British Columbia. G. Clifford Carl. 50 cents.
No. 5 The Fresh-water Fishes of British Columbia. Carl, Clemens, and Lindsey. $1.
No. 6 The Birds of British Columbia: (1) The Woodpeckers; (2) Crows and Their Allies. C. J. Guiguet. 50 cents.
No. 7 The Barnacles of British Columbia. I. E. Cornwall. 50 cents.
No. 8 The Birds of British Columbia: (3) Shorebirds. C. J. Guiguet. 50 cents.
No. 9 The Grasses of British Columbia. W. A. Hubbard. $1.
No. 10 The Birds of British Columbia: (4) Upland Game Birds. C. J. Guiguet. 50 cents.
No. 11 The Mammals of British Columbia. Cowan and Guiguet (new edition). $2.
No. 12 The Ferns and Fern-allies of British Columbia. T. M. C. Taylor. $1.
No. 13 The Birds of British Columbia: (5) Gulls. C. J. Guiguet. 50 cents.
No. 14 Alien Animals in British Columbia. G. C. Carl and C. J. Guiguet. 75 cents.
No. 15 The Birds of British Columbia: (6) Waterfowl. C. J. Guiguet. 50 cents.
No. 16 The Orchids of British Columbia. A. F. Szczawinski. 75 cents.
No. 17 The Intertidal Bivalves of British Columbia. D. B. Quale. 75 cents.
No. 18 The Birds of British Columbia: (7) Owls. C. J. Guiguet. 50 cents.
No. 19 The Heather Family (Ericaceæ) of British Columbia. A. F. Szczawinski. $1.
No. 20 Guide to Common Edible Plants of British Columbia. A. F. Szczawinski and G. A. Hardy. 50 cents.
No. 21 Guide to Marine Life of British Columbia. G. Clifford Carl. $1.
No. 22 The Birds of British Columbia: (8) Chickadees, Thrushes, Kinglets, Waxwings, Pipits, and Shrikes. C. J. Guiguet. 50 cents.
No. 23 Some Common Marine Fishes of British Columbia. G. Clifford Carl. 75 cents.
No. 24 Guide to Common Mushrooms of British Columbia. R. J. Bandoni and A. F. Szczawinski. $1.
No. 25 The Lily Family of British Columbia. T. M. C. Taylor. 75 cents.
No. 26 The Intertidal Univalves of British Columbia. Lela M. Griffith. 75 cents.
No. 27 Guide to Common Seaweeds of British Columbia. Robert F. Scagel. $1.
No. 28 Some Mosses of British Columbia. W. B. Schofield. $1.
No. 29 The Birds of British Columbia: (9) Diving Birds and Tube-nosed Swimmers. C. J. Guiguet. 50 cents.

OCCASIONAL PAPER SERIES

Nos. 1–14, inclusive. (Out of print.)
No. 15 The Mosquitoes of British Columbia. L. Colin Curtis. $1.

Please address order to

PUBLICATIONS,
British Columbia Provincial Museum,
Victoria, British Columbia.

Make cheque or money order payable to the Minister of Finance.